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Differentiating Mass Disasters. The Barzullah Classification.

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SUMMARY

Background. To assess the pattern of mass casualty incidents managed at our hospital over the last eight years, and evolve a differentiating classification based on this pattern. A combination of retrospective and prospective assessment was made.

Material and methods. All patients receiving injuries in mass casualty incidents and managed at our hospital. Patients with an injury severity score above 9. Management of injuries as per the trauma management protocol. Classification based on the data collected during the study and application of this classification to the subsequent mass casualty incidents to allow comparison between similar incidents in different settings.

Results. A classification system that mainly differentiates mass casualty incidents on the hospital basis, the criteria being: the time interval between the first information to first reception, and the percentage of admission above the maximum normal intake.

Conclusions. 1. The Barzullah classification system is the first attempt at developing a hospital based differentiation in mass casualty incidents. 2. It provides a valid and easy method of comparing such incidents between hospitals and perhaps a basis for developing protocol for mass disaster management.

Key words: mass disaster, classification, management

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BACKGROUND

Mass casualty events have several varied features according to the cause. Terrorist attacks, natural disasters and conventional disasters require differentiating considerations [10].

Even though preparing an effective medical response to an urban mass casualty incident is a top priority for trauma system, yet the impact of a large number of casualties on the quality of care for the critically injured remains ill defined [2,3]. The goal of any hospital disaster response is to provide critically injured patients with a level of care comparable to that given to similar patients under normal circumstances [4].

Most of the literature concerning mass disasters pertains to the difficulties in evacuation, field triage and transport of patients. It is often presumed that hospital management would occur as planned [3,5, 6]. Often reports detailing mismatch between the hospital resources and the huge number of patients describe different responses directly related to the time taken by the casualties in arriving at the hospital [6,7].

Hospitals around the world are limited by space and staff constraints and often act as major rate limiting factors in a disaster medical response. Planning for mass disasters at the hospital level requires assessment of hospital inventories at the level of emergency department, intensive care units, operating and post operative rooms besides investigating units like the radiology sections.

The Government Hospital for Bone and Joint Surgery has been in the midst of mass casualty management for the last twenty years with a specialization in orthopaedic trauma. Managing mass injuries in firing incidents, urban improvised explosive device blasts, the Kashmir earthquake of 2005 and a 'snow tsunami' has made disaster management almost a norm for this hospital. We report on the need to differentiate mass disasters by proposing a hospital based classification of mass disasters which would allow better resource utilization and retrospective analysis. This classification also allows an insight into the difficulty in the management of these mass disasters especially if the preparatory time is absent and also if the number of casualties overwhelms the hospital capacity.

MATERIAL AND METHODS

From January 2000 to August 2008, we studied 8 mass casualty incidents prospectively and retrospectively in the Government Hospital for Bone and Joint Surgery.

A mass casualty incident was defined as a situation when the rate and number of arriving casualties was such that it was not possible to treat the patients to the level and with the promptness that is achieved under normal circumstances.

The records of all mass casualty incidents were reviewed and the response to the mass casualty incidents occurring from 2006 onwards, observed. Triage, radiology, referral, theatre and postoperative records were reviewed.

The data was accumulated in terms of:

1. The time interval between the first report received by the hospital about the occurrence of a mass casualty incident and the arrival of the consequent casualties.
2. The number of patients received in each mass casualty incident.
3. The hourly rate of reception of patients.
4. Vital areas in the hospital where the patients and the administration had to face a delay i.e. casualty reception, triage, resuscitation, radiology, surgery, postoperative ward placement, postoperative observation and monitoring.
5. The time taken by the administration to identify idle resources and harness them. The speed at which routine work could be postponed, or cancelled, so that more resources could become available for the management of the mass casualty incident.
6. The effect of time and rate on the surge capacity.
7. The effect on fixed resources.
8. The number of times additional staff requisitioned was able to arrive within the time of maximum need.

All these factors were combined and reviewed. On the basis of the consistency of findings a classification system was proposed.

RESULTS

This study was compiled on the basis of the records and observations made in eight mass casualty incidents over a period of eight years (Tab. 1).

Of the eight randomly selected incidents over an eight year period we were able to differentiate mass casualty incidents in terms of two basic factors.

The first factor was the time interval between the first information of the mass casualty incident and the arrival of the casualties. The interval ranged from getting no prior warning to more than 6 hours of time till the first arrival of casualties.

On this basis we were able to divide the reception interval into 4 groups, with group D being a situation where reception occurred within 15 minutes of the

first information received at the hospital. Similarly a group C situation was said to have occurred when reception occurred from 15 mins to one hour of the first report, group B being 1-6 hours and group A more than six hours from the time of reception of the first reports.

In a group D situation the hospital assets were fully occupied with the routine work. Surge capacity was found to be minimal and redirection of facilities was not possible. Patients had to face a delay in triage, resuscitation and access to theatre facilities and referral. In a group C state the material assets were diverted to management of the incident but man power was difficult to divert as they were not able to leave their routine work in spite of having the information. In a group B situation, man power within the hospital started to focus on the mass disaster. However theatre facilities were still occupied as routine cases were continuing.

Tab. 1. Mass casualty incidents over a period of eight years

S No	Incident	Time of arrival after first information	Total duration	Total number of patients received	Rate of reception per hour	Delay at	Missed injuries	Repeat procedures
1	Lal chowk blast [2000]	15 mins to 1 hour	45 minutes	21	28	Triage, Radiology, operation theatre.	2	8
2	Assembly Blast [2001]	Less than 15 mins	2 hours	40	30	Triage, radiology, operation theatre	4	4
					10	Radiology, operation theatre.		
3	Pulwama Blast [2004]	1-6 hours	1 hour	13	13	Radiology, operation theatre.		
4	Bus accident [2005]	15 mins to 1 hour	30 mins	23	46	Triage, resuscitation, operation theatre, post operative placement and observation.	4	6
5	Snow avalanche [2005]	More than 6 hours	3 hours	21	7	Operation theatre.		
					6	-		
					8	Operation theatre		
6	Kashmir earthquake[2005]	A] 15 mins to 1 hour	45 mins	18	24	Triage, radiology, operation theatre	3	2
		B] 1 hour to 6 hours	2 hours	22	11	radiology, operation theatre		
		C] more than 6 hours	3 days	418	6-10	operation theatre		
7	Bus accident[2006]	Less than 15 minutes	30 minutes	18	36	Triage, resuscitation, operation theatre, post operative placement and observation	2	3
8	Firing incident[2008]	A] 1-6 hours	5 hours	50	10	Triage, operation theatre.		
		B] more than 6 hours	10 hours	57	5.7	Operation theatre		

We observed the total duration of the reception of the mass casualties as also the total number of casualties being received. The data was extrapolated to find out the hourly reception.

Similarly, we divided the mass disasters on the basis of the rate of arrival of casualties per hour. To ensure uniformity we divided mass disasters on the basis of the percentage of patients received above the maximum that is managed normally. In our case it was calculated at 5 patients with an injury severity score above 9 per hour. The classification is shown in Table 2. On this basis type 1 was a mass disaster with the hourly reception overwhelming the normal maximum capacity by 50%. type 2 50-100%, type 3 100-200% and type 4 being an hourly flow more than 200%.

In type 1 it was still possible to manage patients within the surge capacity. In type 2 gradual build up of patients occurred in the acute settings (type C and D situation) In other situations further increase in surge capacity allowed management. In type 3 assets started to fail in the management especially in the acute setting. Patients had to wait for triage, radiographs and theatre facilities. In type 4 there was a waiting period at all levels of management (Tab 3).

This division was based on the response of the hospital resources in such situations. It was observed that there were 4 potential bottle necks. Triage, resuscitation, radiology, operation theatre and post-operative observation.

In disaster situations the hospital resources at these points were challenged with early reception and larger number of hourly patients making it more likely that all points would entail a delay in patient management. This was especially seen in the Kashmir earthquake of 2005.

These sub-classifications are combined to give an assessment of the disaster situation that a hospital finds itself in at a particular point. For example a category D4 disaster means a situation where the hospital has received casualties with no prior warning and the number of patients arriving is more than 200% above the maximum capacity. Similarly a category A1 disaster would mean that the hospital has had more than 6 hours of prior warning and is managing patients at 50% above its normal capacity.

DISCUSSION

The Hospital for Bone and Joint surgery is an orthopaedic speciality hospital situated in the heart of Srinagar city. It has been at the forefront of management of all kinds of orthopaedic trauma. Our experience with mass casualty incidents includes those occurring in the urban setting as well in the rural setting.

A major incident is an emergency that requires the implementation of special arrangements by one or all of the emergency services and will generally include the involvement, either directly or indirectly, of a large number of people [8].

Tab. 2. Classification of mass disasters (see text)

S No	First information to reception interval	Category	Observations
1	0 to 15 minutes	D	The hospital assets are fully occupied with the routine work. Surge capacity is minimal and redirection of facilities is not possible. Patients have to face a delay in triage, resuscitation and access to theatre facilities and referral.
2	15 minutes to 1 hour	C	The material assets are diverted to management of the incident but man power is difficult to divert as they are not able to leave their routine work in spite of having the information.
3	1 hour to 6 hours	B	Man power within the hospital starts to focus on the mass disaster. However theatre facilities are still occupied as routine cases are continuing.
4	More than 6 hours	A	The hospital is fully engaged in mass disaster management and routine work gets suspended.

Tab. 3. Types of mass disasters

S No	Rate of patient arrival	Category	Observations
1	Upto 50% more than maximum capacity. [5 per hour for our hospital]	1	It is still possible to manage patients within the surge capacity.
2	From 50% to 100% more than the maximum capacity	2	Gradual build up of patients occurs in the acute settings [type C and D situation] In other situations further increase in surge capacity allows management.
3	From 100 to 200% more than the maximum capacity	3	Assets start failing in the management especially in the acute setting. Patients have to wait for triage, radiographs and theatre facilities.
4	Above 200% of the maximum capacity	4	The management fails at all levels

Every major disaster warrants retrospective studies so that we can learn how to improve all levels of emergency medical care. Casualties generated in a mass disaster are managed at various levels and by various services. This includes field triage, transport, management by emergency medical services and management in the hospital. Usually mass disaster management focuses mainly on pre-hospital parameters, often presuming that the hospital management would be orderly and streamlined. However, hospitals often have a limited capacity and are unable to generate a requisite response, affecting the quality of patient care. At the hospital level disaster planning may require an altered standard of care.

Dealing with mass casualties in the setting of a mass disaster is one of the challenging topics in trauma management [5].

It is important to realize that in man made disasters, the minimally injured, walking wounded have a tendency to arrive at the local hospitals first, often causing overload and over triage [10].

According to Langworthy et al., a breakdown of resources after a mass disaster revealed that the emergency medical service system was hardly used and that most victims walked or were transported by taxi to the hospital [11].

Planning for large number of casualties falls outside the standard trauma system organized response to injury whereby a locally co-ordinated approach allows for swift management of people. Hospital based trauma programs do provide a reasonable infrastructure for dealing with disaster situation, but require modification and an ability to expand their normal resource network to include interfaces with country, state and national assets [12].

Mass disaster scenarios vary from hospital viewpoint in that the quality of care can be directly affected by the number of casualties admitted and the time taken for them to arrive after the first information of the disaster is received in the hospital.

Lhowe et al. reported that management of the 1995 Oklahoma city bombing was facilitated by its occurrence in an environment where 13 highly developed health care facilities were available to manage the 759 victims brought in for treatment [13]. In stark contrast, 4000 victims overwhelmed available medical resources within hours in the 1998 Nairobi bombing [14].

The goal with mass casualties is to provide the greatest good for the greatest number of patients. The focus shifts from providing care to the sickest to providing care to patients most likely to survive. By deprioritizing the most severely injured who most likely would not survive anyway, this strategy saves the most lives [10].

This kind of strategy can usually be adopted when mass casualty incidents occur at some distance from the hospital, where factors like field triage, evacuation and transport slow immediate referral.

In comparison, in urban mass casualty incidents, arrival is almost immediate. Frykberg wrote that civilians are poorly equipped or prepared to handle the severe emotional, logistical and medical burdens of a sudden large casualty load and are thus completely vulnerable [15]. Often in the urban and close settings, multiple civilians accompany each casualty, often making management difficult.

Ideally, according to Ammons et al, local and regional mass casualty exercises should develop contingency plans to redistribute less injured patients to centers away from an urban trauma epicenter to maintain availability of nearby facilities to manage more severely injured victims [16].

Traumatic injuries are often described as the largest epidemic of the 20th century and are, perhaps mistakenly, looked upon as a homogeneous entity [17,18]. The importance of well-organized pre-hospital trauma care is unquestionable [19].

A major incident plan is designed to summon the right people and services to both the incident and the receiving hospital in order to maximize resources and ensure that the right people are in the right place at the right time [20].

However, the aforementioned variables of time and patient number often preclude the maximization of resources. According to Hirschberg et al, the relationship between casualty load and quality of care is not merely a theoretical question but a crucial aspect of any disaster plan [3].

Surge capacity is the number of critical casualties arriving per unit time that can be managed without compromising the level of care. In essence, it is an arrival rate.

At the hospital level in the best case scenario, the best trauma team would be available, the triage would be conducted by the most experienced trauma team leader, resuscitation would be of the highest quality and there would be an orderly flow of casualties through the casualty, and radio diagnosis to the operating room. The maximum number of critically injured patients flowing through the casualty/hour who have access to all these would be critical capacity of that casualty. Beyond this there will be a gradual failure of assets.

The idea of developing a classification based on the information-to-arrival time and the rate of arrival developed over a period of years on observing that we were able to manage a greater load of patients if the time from the first information to the first recep-

tion was more. This was mainly due to the ability to deploy resources more effectively as also the possibility of delaying work that could be postponed. We also observed that in a surgical setting the occurrence of a higher rate of reception affected the management flow adversely. In essence, we felt that these two aspects of trauma care are not within control of the management of the hospital. An urban mass casualty incident is likely to present the hospital with a greater challenge and a rural incident with field triage and transport issues will challenge a hospital differently.

Our experience with mass disasters and the requirement of orthopaedic surgeons to be at the forefront of mass disaster management has allowed us to see the variable strain on the disaster management infrastructure in terms of the two discussed variables [21.22].

Mass casualty incidents are managed at various levels. The requirement that mass disasters be differentiated at the hospital level is always felt, especially in hospitals at the forefront in trouble-torn areas. In spite of the uniformity in overwhelming hospital resources, mass disasters are different in several respects.

We feel that the classification we have proposed can be useful in the following ways.

1. Comparison of mass disasters managed in various hospitals around the world. It is important to realize that comparing a category D4 mass casualty incident with a category A1 mass disaster is farcical.
2. Informing the site co-ordinators that a hospital is managing a particular mass disaster class at that point in time to allow referral elsewhere.
3. Developing protocols. A single protocol for all situations is not very practical.
4. Resource redirection and allocation.
5. Requirement of reassessment and secondary surveys in higher category disasters.

CONCLUSIONS

1. The Barzullah classification system is the first attempt at developing a hospital based differentiation in mass casualty incidents.
2. It provides a valid and easy method of comparing such incidents between hospitals and perhaps a basis for developing protocol for mass disaster management.

REFERENCES

1 Singer P, Cohan JD, Steen M: Conventional terrorism and critical care. Crit care Med 2005; 33 (suppl); 561-568.
2. Frykberg E R Principle of mass casualty management following terrorist disasters. Ann Surg. 2004; 239. 319-321.
3 Hirschberg A, Scott BG, Granchi T, Wall MJ, Mattox KL, Steem M. How does casualty load affect trauma care in urban bombing incidents? A quantitative analysis. J Trauma 2005; 58: 686- 695.
4. Hirschberg A, Halcomb JB, Mattox KL. Hospital trauma care in multiple casualty incidents: a critical review. Ann Emerg Med. 2001; 37: 647-652.
5. Naghi TM, Kambiz K, Shariar JM et al. Musculoskeletal injuries associated with earthquake; a report of injuries of Iran's December 26, 2003. Bam earthquake casualties managed in tertiary referral centers. Inj Int J Care Inj 2005; 27-32.
6. Dhar SA, Halwai M A, Wani Z A. The Kashmir earthquake experience. Eur J Trauma Emerg Surg 2007 No 1 p 74-80.
7. Watcharong C, Chuckpaiuiong B, Mahaisavariya B. Orthopaedic trauma following tsunami; experience from Phang Ta. Thailand. J Orthop Surg [Hongkong] 2005; 13: 1-2.
8. Regel G, Lohen hoffer P, Lehmann U, Paper HC et al. Ergenesse in der behandlung polytraumatisierter – ane vergluchende analgession 3406 fallen zwischen 1972 and 1991. unfallcherurg 1993; 96; 350- 362.
9. Crippen D. The world trade centre attack; similarities to the 1998 earthquake in America; Time to teach public life supporting first aid.? Crit care 2001; 5: 312 – 4.
10. Hocy BA, Schwab CW. Level 1 center triage and mass casualties. CORR Number 422 pp 23 – 29.
11. Langworthy MJ, Sabra J, Gould M. Terrorism and blast phenomena. Lessons learnt from the attack on the USS Cole (DDG67). CORR Number 422 p 82-87. 2004.
12. Born CT, Delong WG. Organising the orthopaedic trauma association mass casualty response team. CORR Number 422 p 116, 2004.
13. Lhowe DW, Briggs SM. Planning for mass civilian casualties overseas. CORR Number 422 p 109-113.
14. Macintyre AG, War S, Barbera JA: The international search and rescue response to the US embassy bombing in Kenya: The medical team experience. Prehospital Disaster Med 14; 215 – 221, 1999.
15. Frykberg E. Medical management of disasters and mass casualties from terrorist bombings. How can we cope. J Trauma 53: 201-212. 2002.
16. Ammons MA, Moore EE, Pons PT et al. The role of regional trauma system in the management of a mass disaster. An analysis of the Keystone. Colarodo chair lift accident. j trauma. 28: 1468 – 1471. 1988.
17. Dhal R. Vehicular Manslaughter: The global epidemic of traffic deaths. Environ health perspective. 2004; 112.
18. Nufer KE, Wilson-Ramirez G. A comparison of patient needs following two hurricanes. Prehosp Disaster Med. 2004 Apr--Jun; 19 (2): 146-9.
19. Pamerneckas A, Macas A, Vaitkatis D, Vaitkatis A, Gudenience R. Golden hour early post injury period. Medicina 2003; 9: 845 -851.
20. Wong K, Tarner PS, Bopanna A et al. Preparation for the next major incident; are we ready? Emerg Med J 2006; 23: 709-712.
21. Marsh JA; Editorial: Disaster and mass casualties. J Am Acad Orthop Surg 2007; 15: 378 – 379.