A Multicasualty Event: Out-of-hospital and In-hospital Organizational Aspects

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Abstract

In a wedding celebration of 700 participants, the third floor of the hall in which the celebration was taking place suddenly collapsed. While the walls remained intact, all three floors of the building collapsed, causing Israel's largest disaster. **Objectives:** To study the management of a multicasualty event (MCE), in the out-of-hospital and in-hospital phases, including rescue, emergency medical services (EMS) deployment and evacuation of casualties, emergency department (ED) deployment, recalling staff, medical care, imaging procedures, hospitalization, secondary referral, and interhospital transfer of patients. **Methods:** Data on all the victims who arrived at the four EDs in Jerusalem were collected through medical files, telephone interviews, and hospital computerized information. **Results:** The disaster resulted in 23 fatalities and 315 injured people; 43% were hospitalized. During the first hour, 42% were evacuated and after seven hours the scene was empty. Ninety-seven basic life support ambulances, 18 mobile intensive care units, 600 emergency medical technicians, 40 paramedics, and 15 physicians took part in the out-of-hospital stage. At the hospitals, about 1,300 staff members arrived immediately, either on demand or voluntarily, a number that seems too large for this disaster. Computed tomography (CT) demand was over its capability. **Conclusions:** During this MCE, the authors observed ''rotating'' bottleneck phenomena within out-of-hospital and in-hospital systems. For maximal efficiency, hospitals need to fully coordinate the influx and transfer of patients with out-of-hospital rescue services as well as with other hospitals. Each hospital has to immediately deploy its operational center, which will manage and monitor the hospital's resources and facilitate coordination with the relevant institutions. **Key words:** multicasualty event; mass-casualty event; hospitals; emergency medical services; disaster management. ACADEMIC EMERGENCY MEDICINE 2004; 11:1102–1104.

During a wedding party of 700 guests in Jerusalem, Israel, the middle section of the third floor of the wedding hall suddenly collapsed. The guests in this section fell to the second floor, continuing through the first floor, and into the basement. The ceiling, walls, and supporting columns of the building remained intact. This multicasualty event (MCE) occurred during a period of repeated terrorist attacks in Israel; health care providers already had experience in the treatment of MCEs.[1]

In Israel, the police are responsible for the overall command of an MCE site.[2] Almost all out-of-hospital care is provided by the Magen David Adom (MDA) emergency medical services (EMS) system. Approximately 600 ambulances are stationed across the country, enabling their dispatch to any site within minutes. About a tenth of all ambulances are mobile intensive care units, staffed with a physician and a paramedic or with two paramedics, and are specially equipped with advanced life support (ALS) facilities. The senior paramedic on site assumes command of all medical teams and establishes a triage and resuscitation center, from which the casualties are dispatched to hospitals after receiving immediate necessary life support on site and during transportation. The distribution of casualties to hospitals is controlled by the medical commander on site and coordinated by the area dispatch center. This out-of-hospital system, integrated with all general hospitals and the Home Front Command, has proven to be effective in previous wars and recent emergencies.

This report presents the application of lessons learned from terror events regarding the organizational process for a health system deployment in an MCE including rescue and out-of-hospital care

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and hospital deployment during a sudden influx of casualties, staff recalling, triage and medical care, imaging procedures, hospitalization, secondary referral to other hospitals, and interhospital transfer of patients.

METHODS

Study Design. This study involved a prospective data collection on the victims of an MCE in Jerusalem, Israel, in order to study the coordination of out-of-hospital and in-hospital resources in response to the disaster. The study was considered exempt from review.

Study Setting and Population. Data were collected on all the victims of the ''Versailles disaster'' (so called after the name of the wedding hall) who were admitted to all four general hospitals in Jerusalem between May 24 and May 27, 2001. Only one hospital is a Level 1 trauma center. Two other hospitals have main relevant departments, except neurosurgery and burn unit, and the remaining one lacks an orthopedic department and other surgical subspecialties.

Study Protocol. Telephone interviews were performed within 45 to 90 days after the event (75% response) regarding the circumstances of the event. Data on duration of evacuation, special tests, diagnosis, and procedures, including computed tomography (CT), were collected from medical files. Data on staff present during the emergency were obtained from administration records.

Data Analysis. Descriptive analysis of the collected data was performed.

RESULTS

Circumstances. The ''Versailles disaster'' resulted in 338 casualties (48% of 700 guests), of whom 23 died and 315 were injured. The age range was 2 to 77 years; half were 15 to 34 years of age. Injuries were mainly caused by the fall itself, and by the crushing of one person into another. Eighty-one percent of the casualties stood on or near the dance floor prior to the collapse. Fifty-nine percent of the victims described a multiphase drop, namely, they fell through three floors, each of which attenuated the speed of their fall, until the victims finally came to rest on the lowest floor. During their fall, 70% of the victims were hit by building debris and other people.

Rescue and Evacuation. The first call was received by the police and by the MDA dispatch center at 22:42 hours. More than 30 ambulances from the Jerusalem region were immediately dispatched to the scene. Simultaneously, additional ambulances and emergency teams were mobilized from more distant MDA regions; most of them were not needed on site and were held in reserve. MDA mobilized a total of approximately 600 emergency medical technicians (EMTs), 40 paramedics, and 15 physicians operating 97 basic life support (BLS) ambulances (staffed by a driver and an EMT), 18 mobile intensive care vehicles, and six mobile first aid stations.

Evacuation Time. The local MDA ambulances, with an ambulance turnover time of 30 minutes, evacuated most of the casualties. Within the first hour, 130 victims (42%) were evacuated and another 105 (33%) were evacuated during the next hour. The primary evacuation operation took about four hours, including the time for extrication and primary care.

Emergency Department (ED) Admissions. The first casualties reached the hospital at 23:06 hours, 21 minutes after the collapse. The influx of casualties lasted until 3:00 hours the next day. Thereafter, admissions occurred in smaller numbers and at longer intervals, up until three days following the event. Within the first hour, 188 casualties (60%) arrived at the four hospitals.

Even though patients were distributed among all four hospitals, the influx of casualties was particularly heavy to the Level 1 trauma center and one other major hospital, lasting one to three hours after the event. In the other two hospitals, arrivals were more evenly distributed over time.

For all hospitals, evacuation time for the severest casualties (those who were eventually hospitalized) was shorter. Half of the hospitalized cases arrived within 69.5 to 76.5 minutes, whereas half of the victims eventually released from the ED arrived within 89 to 150 minutes (Kruskal-Wallis test, $p < 0.001$).

Interhospital Transfers. In total, there were 347 ED admissions for 315 casualties. Thirty-two casualties were transferred from one hospital to another.

ED Operation. Each of the hospitals admitted casualties, exceeding the regular capacity of its ED. The initial preevent ED occupancy rate was between 73% and 164%. Following the event, the occupancy rate was 163% to 268%. Approximately 1,300 hospital personnel (including medical, paramedical, technical, and administrative staff) arrived at all hospitals.

Utilization of CT Scans. CT scans were one of the most prevalent examinations performed. In the trauma center, 61 CT scans were performed on 39 casualties within 12 hours of admission, by means of two scanners. One third of the scans were performed within the first three hours; 75% of the scans were completed by early the next morning.

Hospitalization. Of all casualties admitted to the EDs, 134 (43%) were hospitalized. Most suffered from mild to moderate injuries; 42% had an Injury Severity Score (ISS)[3] of between 9 and 15, and 22% had an ISS of 16 or higher. The diagnoses were defined by the International Classification of Diseases (ICD)-9[4] and were distributed by body areas according to the Barell matrix.[5] For 13% of the patients, no diagnosis was reported. Seventy percent of the hospitalized patients suffered from multiple injuries: 32 casualties were injured in an isolated body region, 52 in two body regions, 17 in three body regions, and four in four body regions. Injuries in the lower limbs (56%) and torso (44%) were the most frequent. The latter, which included pelvic fractures, were also the most severe (25% had an ISS higher than 16).

Approximately 13% of the victims were hospitalized for more than two weeks, with 49% to 74% being hospitalized in the orthopedics departments. In the trauma center, 17% of the patients were hospitalized in different intensive care units. Because of a lack of beds, 15% of those hospitalized in the trauma center with isolated orthopedic injuries were hospitalized in other departments.

DISCUSSION

The collapse of the Versailles Wedding Hall was the largest MCE experienced in Israel during peacetime. Most of the casualties suffered from blunt trauma. The injuries were different and more severe than the penetrating and blast type injuries sustained in terrorist attacks, which are predominantly caused by bomb fragments, weapon projectiles, and blast impacts.

The main lessons learned from this MCE include the following:

1. A unified medical command system facilitates rapid response on scene, full utilization of all medical resources, and early evacuation and triage of casualties to nearby hospitals.
2. In view of limited access routes and space at the scene and the gradual extraction of the casualties from the building, the automatic dispatching of a large number of ambulances to the incident site should have been reconsidered.
3. Treatment at the incident site was limited to triage and lifesaving procedures only, and did not cause the deterioration of the medical condition of the casualties.
4. Contrary to plans for deploying hospital medical teams to MCE sites,[6] we believe that these teams are needed more in the local receiving hospitals and that well-trained ambulance teams are better equipped to manage casualties in the field.
5. The deployment of MDA Ambulance Services liaison officers to the EDs contributed to better coordination between the EMS and the hospitals.
6. In any major MCE, several ''bottlenecks'' in casualty management will occur in the out-of-hospital and in-hospital settings. At the incident site, security considerations and/or the extrication of the victims may delay treatment and evacuation, and in the ED and in the imaging units, a sudden influx of casualties may cause a delay in their treatment. If many patients require urgent surgical interventions, another bottleneck may be created in the operating theaters.

In order to minimize these ''bottlenecks,'' a one-directional flow of patients has already been introduced, in which the patient proceeds to the next station for investigation and further treatment without returning to the ED. The patients with minor or mild injuries can receive care and be discharged from another location in the hospital, such as an outpatient clinic.

Severely injured patients, whose surgery may be delayed because of patient volume or resource overload, should be evacuated without undue delay to another hospital.

CONCLUSIONS

Guidelines[7] and drills are the standard ways of preparing for an MCE, although compliance is not ensured in the actual situation.[6] Previous experience with terror victims contributed to the quick response of EMS and the full utilization of all resources, even in an MCE of such magnitude.

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