Review

11 March 2004: The terrorist bomb explosions in Madrid, Spain – an analysis of the logistics, injuries sustained and clinical management of casualties treated at the closest hospital

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Abstract

At 07:39 on 11 March 2004, 10 terrorist bomb explosions occurred almost simultaneously in four commuter trains in Madrid, Spain, killing 177 people instantly and injuring more than 2000. There were 14 subsequent in-hospital deaths, bringing the ultimate death toll to 191. This report describes the organization of clinical management and patterns of injuries in casualties who were taken to the closest hospital, with an emphasis on the critically ill. A total of 312 patients were taken to the hospital and 91 patients were hospitalized, of whom 89 (28.5%) remained in hospital for longer than 24 hours. Sixty-two patients had only superficial bruises or emotional shock, but the remaining 250 patients had more severe injuries. Data on 243 of these 250 patients form the basis of this report. Tympanic perforation occurred in 41% of 243 victims with moderate-to-severe trauma, chest injuries in 40%, shrapnel wounds in 36%, fractures in 18%, first-degree or second-degree burns in 18%, eye lesions in 18%, head trauma in 12% and abdominal injuries in 5%. Between 08:00 and 17:00, 34 surgical interventions were performed in 32 patients. Twenty-nine casualties (12% of the total, or 32.5% of those hospitalized) were deemed to be in a critical condition, and two of these died within minutes of arrival. The other 27 survived to admission to intensive care units, and three of them died, bringing the critical mortality rate to 17.2% (5/29). The mean Injury Severity Score and Acute Physiology and Chronic Health Evaluation II scores for critically ill patients were 34 and 23, respectively. Among these critically ill patients, soft tissue and musculoskeletal injuries predominated in 85% of cases, ear blast injury was identified in 67% and blast lung injury was present in 63%. Fifty-two per cent suffered head trauma. Over-triage to the closest hospital probably occurred, and the time of the blasts proved to be crucial to the the adequacy of the medical and surgical response. The number of blast lung injuries seen is probably the largest reported by a single institution, and the critical mortality rate was reasonably low.

Keywords blast lung injury, casualties, explosions, terrorism

APACHE = Acute Physiology and Chronic Health Evaluation; BLI = blast lung injury; ED = emergency department; GMUGH = Gregorio Marañón University General Hospital; ICU = intensive care unit; ISS = Injury Severity Score.

Introduction

Massacres resulting from bombing are historically among the most common forms of terrorist violence and present with a unique epidemiology [1]. They cause specific lesions, such as those due to the primary effect of blast. Most critical body system injuries are found among those who are killed immediately, and these are the same body system injuries that most commonly cause death in all other forms of trauma [2].

Terrorist bombings around the world during the past 35 years have occurred primarily in urban areas; they frequently generated multiple casualties, but local medical resources were adequate to provide care for victims [2–6]. True mass casualty events are a very different situation, and by definition they involve such large numbers of victims, or such severe or unique injuries that local medical resources cannot fully cope with them. The most important way to prepare for the large casualty loads caused by bombing disasters is to understand the patterns of injuries and logistical problems that result. A retrospective analysis of implemented organization and clinical management can identify helpful decisions and errors [2].

This report provides a detailed review of in-hospital triage, patterns of injuries and care for victims treated at the closest hospital, with an emphasis on the critically ill.

Methods

On Thursday 11 March 2004, a terrorist bomb attack was perpetrated in Madrid, Spain, which led to one of the most calamitous mass injury situations of its kind in Europe during recent decades. Ten bags containing charges of TNT (trinitrotoluene) were detonated in four commuter trains at rush hour; the trains were at different train stations in the centre of town. The explosions took place between 07:39 and 07:42, and all emergency services were immediately alerted. Overall data on the number of victims treated at the different hospitals, primary care facilities and at the scene, as well as the logistics involved, were reported by the Health Authority of the 'Comunidad de Madrid' Local Government. Data on the patients received at Gregorio Marañón University General Hospital (GMUGH), surgical organization and resources used were in part kept concurrently by the authors, and in part obtained retrospectively by chart review.

We defined as 'critical' any casualty presenting with an acute airway, or breathing, circulatory or neurological problems that required immediate surgical intervention and/or admission to an intensive care unit (ICU), and all patients admitted with endotracheal intubation. Neurological status was quickly assessed when appropriate using the Glasgow Coma Scale. The degree of severity in critically ill patients was assessed using the Injury Severity Score (ISS) and Acute Physiology and Chronic Health Evaluation (APACHE) II score during the first 24 hours of admission to the ICU. Blast lung injury (BLI) was diagnosed on the basis of hypoxaemia and characteristic radiographic lung opacities, with or without pneumothorax, and absence of rib fractures or chest wall injury [7]. Nevertheless, it is well known that the presence of chest wall injury does not necessarily exclude BLI; it just makes it harder to diagnose. Fisher's exact test and χ^2 tests were used to compare the group with BLI versus the group with lung contusions resulting from chest wall trauma.

Results

Initial emergency treatment and triage was carried out by emergency medical services near the scenes of the blasts, and the victims were subsequently transferred to GMUGH and other hospitals. The vast majority of survivors were evacuated by ambulance and many others by private vehicles. Most casualties arrived between 8:00 and 11:00.

According to official information, at 21:00 on that day 1430 casualties had been treated, 966 of whom were taken to 15 public community hospitals. The two largests public hospitals in Madrid (GMUGH and 12 de Octubre University General Hospital, with 1800 and 1300 beds, respectively) received around 53% of those casualties. The other victims were treated in primary care facilities and near the scenes of the blasts. Many other casualties with mild injuries were received at different facilities on the days following the blasts. Very few patients were taken to private hospitals.

The explosions resulted in 2062 casualties, 177 (8.6%) of whom were killed immediately (deaths at the scene). There were 14 subsequent deaths (in-hospital deaths), which occurred either on the same day or later on, among 82 victims who were reported to be in a critical condition at 21:00 on that day, bringing the total death toll to 191 and the overall 'critical mortality' rate to 17%.

According to official information, the resources mobilized to care for the wounded and their families was unprecedented in our country, with over 70,000 health personnel involved, 291 ambulances for transport, 200 firemen, 13 groups of psychologists, 500 volunteers, thousands of donations of blood at hospitals and in 10 mobile units, and 1725 blood donors from other regions of the country. In addition, more than €26,540,544 was estimated to have been spent on insurance and compensation for families of the dead. The 112 emergency communication centres received more than 20,000 phone calls during the morning of the blasts.

A total of 312 casualties were treated at GMUGH, 272 of them between 08:00 and 10:30. No secondary transfer of patients was made to or from GMUGH. The mean age of victims was 32 years (range 14–63 years) and 59% were males. Of the 312 victims, 62 had no signs or symptoms other than superficial bruises or emotional shock, and these were treated with a mild sedative and support from qualified personnel. The remaining 250 had more severe lesions, and data on 243 of them were retrieved and form the basis of this report. Eighty-nine victims (28.5% of the 312 victims) were admitted to hospital for more than 24 hours, and 29 (12% of the total 243, or 32.5% of those admitted) were deemed to be in a critical condition. By 31 March 2004, only 30 patients remained hospitalized, five of whom were in a critical condition. The last patient was discharged home on 2 August 2004. No correlation between old age and length of stay was observed, but patients with burns had longer hospital stays.

The rate of over-triage to GMUGH was well over 50%, and the under-triage rate was zero.

Organization and logistics of the management of the mass casualty situation at GMUGH

GMUGH is a 1800-bed teaching public hospital, serving a population of more than 650,000 people, and is located in the centre of Madrid, near Atocha railway station, which was the epicentre of the terrorist attack. At 07:59 the first victim walked into the emergency department (ED) suffering from an ear blast injury.

Immediate action was taken to cancel all scheduled surgical interventions in the 22 available rooms, and 161 hospitalized patients were discharged home from the various wards in under 2 hours. A number of patients in the ICU and surgical ICU, with 28 beds in total, were evacuated to intermediate care units, as deemed appropriate. The recovery room, with a maximum capacity of 10–12 beds and adjacent to the surgical ICU, was also made available to receive critically ill patients. The 123 patients who were kept under observation at the ED at 07:30, before the blasts occurred, were either discharged home when appropriate or transferred to the wards, and only 10 of them remained in the ED at 09:30. All elective diagnostic procedures were deferred. At the same time, the Teaching Pavillion, adjacent to the ED, was used as an information center for the families, authorities and the media.

Triage was performed by senior faculty members at the entrance to the ED and continued until around 10:30. Two patients were directly taken for surgery, and most intubated patients and those who looked to be critically ill were immediately taken to the adjacent ‘shock room’ and other nearby rooms for primary survey and resuscitation, in accordance with Advanced Trauma Life Support protocols. Our shock room has the capacity to treat three to four severely injured patients simultaneously. Teams of general surgeons and anaesthesiologists examined all of the critically ill patients initially, and the need for further examination by subspecialty teams such as orthopaedic, neurosurgical, cardiovascular, thoracic, maxillofacial and plastic surgical teams was determined. All patients were examined, at some time during the day or later, by ear, nose and throat teams to rule out injury to the tympanic membrane.

Out of more than 27 victims assessed in the shock rooms, seven haemodynamically unstable patients were immediately taken for surgery and the others were triaged to radiology departments or ICUs. In these units, further assessment was undertaken and additional patients sent for surgery. Minor casualties were triaged to different areas of the ED for assessment, wound dressing and suturing.

Focused abdominal sonography for trauma was performed in 37 patients during the first 3 hours, at different rooms and units, and 40 spiral computed tomography scans had been done by the end of the day, as well as 270 plain radiographs and three vascular interventional radiology procedures. The blood bank delivered 145 units of type-specific blood during the day (90 of them in the first 4 hours), 60 units of fresh frozen plasma and 75 units of platelets.

The absence of previous experience with a mass casualty event of that proportion was probably counterbalanced by the commitment of every person directly or indirectly involved in the treatment of victims and by spontaneous leadership assumed in different areas. All in all, common sense, diligence in triage of patients and serenity seemed to prevail after the initial chaos and emotional trauma, which are unavoidable and common to such situations. There was in fact an abundance of medical teams, nursing staff and resources to treat the critically injured, and no critically injured patient experienced a delay in treatment.

Injuries sustained, mortality and surgical interventions

Many of the 243 assessed casualties were walking wounded and their injuries were minor-to-moderate, requiring only simple dressing or sutures, but some wounds were grossly contaminated and with much tissue loss.

The most frequent injuries found in the 243 victims were tympanic membrane perforations, chest injuries, shrapnel wounds and fractures. Table 1 summarizes the most frequent types of injuries sustained; there is significant overlap among the groups because many if not most patients had more than one injury or fracture.

No patients were dead on arrival, but five died subsequently, two of them shortly after admission. One of the latter was a moribund patient who died at the ED within minutes of her arrival, probably from severe head trauma. Another died with an open cranial wound while being readied for surgical intervention. A third patient died in the ICU at 10:30 from bilateral lung contusion and a thoracic aorta tear. A fourth victim died on that morning while undergoing damage control laparotomy. The only death in a patient who had survived for more than 24 hours was due to multiple organ failure, and this death occurred on the day 7 after admission. She was 22 years old, and had bilateral hemopneumothorax and lung contusion, maxillofacial fractures and avulsion of the left ear, apart from first-degree and second-degree burns. The five fatalities are included in the critical care group of 29 patients, and so our critical mortality rate was 17.2%. If the two patients

Table 1

Main types of injuries sustained in the overall and critical patients populations at Gregorio Marañón University General Hospital

Injuries	Overall population ($n = 243$)	Critically ill patients ($n = 27$)
Tympanic perforation:	99 (41%)	18 (67%)
Unilateral	27 (11%)	1
Bilateral	72 (29%)	17
Chest:	97 (40%)	24 (89%)
Rib fractures	18 (7%)	7 (26%)
BLI	17 (7%)	17 (63%)
Pneumothorax	11 (4%)	10 (37%)
Haemothorax	6 (2%)	6 (25%)
Shrapnel wounds (soft tissues):	89 (36%)	23 (85%)
Head–neck	53 (21%)	
Trunk	11 (4%)	
Extremities	25 (10%)	
Fractures	44 (18%)	15 (55%)
Long bones	18 (7%)	9 (33%)
Maxillofacial	16 (6%)	8 (29%)
Metatarsal	8 (3%)	
Spine	5 (2%)	5 (18%)
Burns:	45 (18%)	16 (59%)
First degree	16 (6%)	
Second degree	29 (12%)	
Eyes	41 (16%)	4 (15%)
Head trauma:	29 (12%)	14 (52%)
Fractured skull base		5
Brain contusions		4
Subdural hematoma		4
Other		12
Abdominal:	12 (5%)	10 (37%)
Liver	5	4
Spleen	4	4
Bowel	3	3
Kidney	3	2
Amputations:	13 (5%)	9 (33%)
Ear	11	8 (29%)
Finger	1	
Left lower limb	1	1
Post-traumatic stress disorder	22 (9%)	

Values are expressed as *n* or as *n* (%). BLI, blast lung injury.

who arrived *in extremis* and became immediate fatalities are excluded, then the critical mortality rate becomes 11%.

Between 08:00 and 17:00, 34 surgical interventions were performed in 32 victims and in 19 different rooms; one of these patients died (as mentioned above) while undergoing unplanned revision for continued bleeding after a damage control laparotomy. Later in the day, three more interventions were conducted. A 27-year-old woman with catastrophic injuries to her left leg (open femur and tibia fractures, and severe bleeding and loss of tissue), in addition to other severe injuries, was operated on three times, bringing to 37 the number of interventions and 34 the number of victims who underwent surgery on an urgent or emergency basis that day. Many procedures required collaboration among different surgical specialties, and soft tissue and musculoskeletal injuries accounted for almost 50% of all operations performed. Table 2 shows the 37 major surgical procedures conducted in 34 patients during the first 24 hours. Minor procedures such as minor plastic suturing and wound debridement were also performed in many of these patients. By the end of the first week, 11 further interventions had been performed, mainly orthopaedic and plastic surgery procedures. Of the seven laparotomies performed on that day, one was nontherapeutic and two were negative, one of them with an associated negative thoracotomy. One patient underwent splenectomy and two underwent bowel resection and bowel suture. Only the patient with the damage control laparotomy died. He had a large open abdominal wound with embedded shrapnel and evisceration, a shattered right colon and profuse retroperitoneal bleeding, apart from head trauma that could not be assessed.

Table 2

Types and numbers of surgical interventions performed in 34 victims during the first 24 hours

Type of intervention	Number ($n = 37$)
Orthopaedic	15 (40.5%)
Abdominal	7 (18.9%)
Neurosurgical	6 (16.2%)
Maxillofacial	5 (13.5%)
Plastic	3 (8.1%)
Ophthalmic	1 (2.7%)

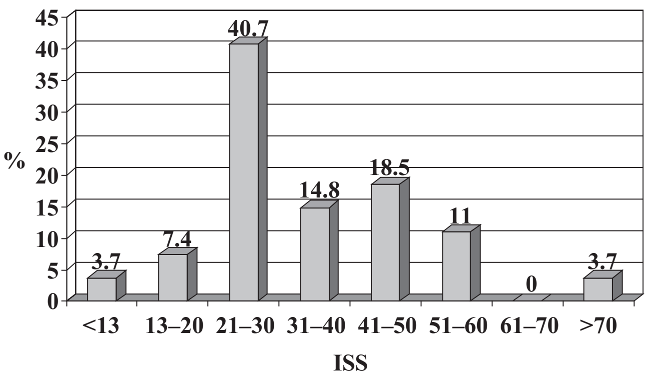
Values are expressed as *n* (%).

The three vascular interventional radiology procedures performed were for embolization of the intercostal artery, hepatic bleeding and hepatosplenic bleeding. The two patients with hepatic bleeding had also previously undergone craniotomy for large subdural haematomas. All three interventional procedures were successful in stopping the bleeding.

Critical patient population

Twenty-seven critically ill patients survived initially to be admitted to ICUs; as mentioned above, three of these patients died. The ICU and hospital stays (mean ± standard error) were 10 ± 4 and 18 ± 6 days, respectively. The mean ISS and APACHE II scores were 34 and 23, respectively. Figure 1 shows the distribution by ISS intervals. The ISS of the three patients who died were 75, 57 and 57. Table 1 shows the different injuries, as compared with the overall population, and all ICU patients sustained multiple injuries. Of all critically ill patients 67% presented with ear blast injuries,

Figure 1



Injury Severity Score (ISS) distribution in the critically ill patients.

Table 3

Comparison between patients with blast lung injury and those with lung contusion and chest wall trauma

Parameter	BLI ($n = 17$)	Chest wall trauma ($n = 7$)	P
Mechanical ventilation	87%	100%	NS ($P = 0.49$)
Days of mechanical ventilation	5.35	8.75	NS ($P > 0.05$)
ARDS	24%	25%	NS ($P = 0.58$)
VAP	13%	35%	NS ($P = 0.32$)
Mean ISS	31	34	NS ($P > 0.05$)

ARDS, acute respiratory distress syndrome; BLI, blast lung injury; ISS, Injury Severity Score; VAP, ventilator-associated pneumonia.

and in eight patients the damage to the tympanic membrane was combined with burns and avulsions of the ear.

Twenty-four critical patients had lung lesions; 17 of them had BLI and seven had lung damage associated with injury to the chest wall. These lung injuries were bilateral in 71% of all cases. Of all critically ill patients 80% required mechanical ventilation for respiratory failure or coma, and 37% were mechanically ventilated for more than 7 days. We identified two different cohorts of patients according to whether the lung damage was associated with chest wall injury or not, and found that those with associated chest wall injury had more prolonged ventilation and a greater incidence of ventilator-associated pneumonia, but the differences were not statistically significant (Table 3).

According to computed tomography scans, the severity of head injuries was assessed as severe in 60%, moderate in 13% and mild in 27% of the critically ill patients. Fractures to the base of the skull and brain contusions were the most common findings, whereas subarachnoid haemorrhage and brain swelling were also frequent.

Ten critically ill patients had abdominal injuries, and half of them underwent surgical treatment. In three patients the treatment was conservative and two required an interventional radiology procedure to control bleeding, as mentioned above. One-third of this critically ill population suffered fractures to extremities. Of these 60% were open and often associated with gross soft tissue damage. They were evenly distributed in the upper and lower limbs. Almost as many patients had maxillofacial fractures. Traumatic amputation of one ear proved to be a marker of severity, and only one critically ill patient arrived with a major traumatic amputation of the left lower limb (Table 1).

Four patients (15%), all of them severely wounded, presented with eye lesions. Three of them were very severe, with one traumatic unilateral enucleation, two blast eyes with intraocular haemorrhage, and two perforations with an intraocular foreign body, each resulting in partial or total loss of sight.

Discussion

Injuries resulting from bombs and exploding munitions have been analyzed extensively and described in a large number of publications. Victims very often suffer the worst forms of both blunt and penetrating trauma. The three major causes of injuries in such incidents include the blast effect or shock wave, flash burns from the heat of the explosion, and penetrating wounds from the ballistic effects of the shrapnel [2–6,8–14].

Indoor detonations tend to cause more severe primary blast injuries than do open air, outdoor bombings. Leibovici and coworkers [10] documented a 7.8% mortality rate among 204 casualties involved in open air bombings in Jerusalem, and a 49% mortality rate among 93 victims of detonations inside buses.

One of the most consistent injury patterns noted among survivors of terrorist bombings is the overwhelming predominance of relatively minor, noncritical injuries that are not life-threatening [3,4,6,14]. These are usually caused by secondary and tertiary blast effects, and are typically soft tissue and skeletal injuries that nevertheless tend to be extensive and contaminated, and require multiple procedures. Among survivors at GMUGH, soft tissue, musculoskeletal and ear blast injuries predominated in up to 80% of cases, but mostly they were noncritical in severity and contributed virtually nothing to mortality. There were multiple contaminated wounds containing various debris and fragments. Wound debridement in these patients was necessary to prevent infection and accounted for more than a third of all operations performed in the first 24 hours.

The incidence of critical injuries among survivors varies between 9% and 22% [2]. Chest and abdominal injuries, including BLI, and traumatic amputations occur very infrequently among survivors of bombings, because the most critical cases are selected out by the initial blast, succumbing to immediate death [15]. However, the few surviving patients with these injuries have a substantial specific mortality, and these injuries should be recognized as prognostic markers of severity.

Most victims of primary BLI from explosions are killed immediately, and late deaths among the small number of survivors with this injury are caused by progressive pulmonary insufficiency, which has all the radiographic and pathologic signs of parenchymal haemorrhage, similar to blunt contusions. The 63% incidence (17 cases) of BLI seen in our critically ill patients, which is higher than previously reported [7], probably reflects a bias in triage of many severely wounded patients to our hospital, which was closest to the blasts.

In a similar way, the ear – an organ that is very sensitive to blast injury – was damaged at a percentage similar to that for lung. The majority of critically ill patients had both lesions, and in these circumstances one should check for both injuries when the other is present.

Traumatic amputation is frequently associated with other critical injuries and a high mortality rate [4], and only one of our surviving patients arrived with a major traumatic amputation. Severe head injury is very common and is also a leading cause of death in victims of blasts, and was probably the major contributing cause in two of our five fatalities. Burns are also relatively infrequent among survivors of bombings and tend to be mild flash burns with low mortality [4].

Recent experience from Israel shows that injuries from terrorist acts, including explosions and gunshots, are severe (ISS >15) in one-third of the population arriving at hospitals alive, with 26% needing admission to the ICU, 55% having open wounds, 31% having internal injuries, and 50% undergoing a procedure in the operating room [13]. Also, the mortality rate was twofold higher than inpatient death following road traffic casualties, although the deaths were mainly due to gunshot wounds. The high mean ISS and APACHE II scores in our critically ill patients reflects the severity of their injuries and clinical condition.

Emotional shock is a common consequence of terrorist bombings. Although it is not as lethal as physical injury, there is significant potential for long-term psychological disability. This should be considered to be in the same category as other major injuries that are in need of treatment [2]. Psychological assistance was very important in the Madrid bombings, and most wounded victims and their relatives suffered from post-traumatic stress syndrome, which required specific treatment.

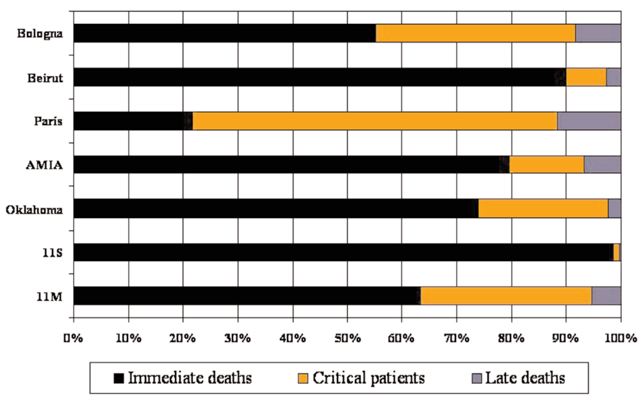
Over-triage, or the rate of noncritically injured being evacuated or hospitalized, was high in the Madrid bombings, which is similar to rates reported elsewhere [4,6]. It has been postulated that, in a mass casualty disaster, this over-triage could be as life-threatening as under-triage because of the inundation of overwhelmed medical facilities with large numbers of noncritical casualties all at once, which could jeopardize the survival of critically ill patients [2]. This did not appear to play a role at GMUGH in view of our critical mortality rate, and the under-triage was zero. Casualties assigned to immediate hospital care must be assessed and treated as quickly as possible, receiving only ‘minimal acceptable care’ during the initial phase of casualty influx [15]. Some authors consider under-triage unavoidable during initial hospital evaluation in these chaotic situations, stressing the importance of repeated surveys [16]. The recent uprising in Israel introduced a previously unknown form of injury created by new types of projectiles such as nails, bolts and other sharp metal objects included in the explosives, causing penetrating injuries that are difficult to detect. As a result, even victims who arrive at the hospital with apparently minimal injuries may require close observation and diagnostic screening [16].

A liberal approach to early abdominal, head, and thoracic operations is warranted in those with critical injuries to these areas in view of their high specific mortality, and tube thoracostomy and laparotomy can be applied on the basis of clinical findings alone [2]. In this respect, two of our seven laparotomies were negative and another one was non-therapeutic – a finding that is consistent with the experience of others [14]. In addition, surgery must be truncated in accordance with the principles of damage control, allowing rapid turnover of rooms [2].

Given the relative rarity of severe civilian penetrating trauma and the lack of large urban general hospitals in the Spanish National Health System that are categorized as trauma centres, very few centres treat more than 120 severe trauma cases (ISS >15) per year. Nevertheless, the experience of the medical, nursing and ancillary staff at GMUGH with everyday blunt civilian trauma and occasional victims of other terrorist acts (mainly ETA [Euzkadi Ta Askatasuna] terrorism) might have contributed somewhat to the rapid evaluation, early operative intervention, and good-to-excellent outcomes in most seriously injured patients.

Since the 1960s, numerous series have been published that provide the information required for analysis of injuries and mortality patterns. The ‘critical mortality rate’ – the death rate among the critically injured survivors – more accurately reflects the magnitude of the disaster and the results of medical management than does the overall mortality rate, and so it should be used when comparing the outcomes from different disasters [4]. Figure 2 compares the percentage of immediate and late deaths, and the percentage of critically ill patients taken to hospitals in some of the worst mass casualty situations resulting from terrorists attacks in recent

Figure 2



Comparison of immediate deaths, critically ill patients (critical patients) and late deaths between the Madrid bombings and other terrorist actions. AMIA, Argentine Israeli Mutual Association; 11M, March 11 terrorist bombings in Madrid; 11S, September 11 terrorist attack in New York.

decades. As Frykberg pointed out in a comprehensive review [2], those mass casualty situations with an added impact of building collapse, as in Beirut and on 11 September 2001 in New York, had a much higher rate of immediate to late deaths, and a lower percentage of critically ill patients. Our 17.2% critical mortality rate was similar to that in other published series. Nevertheless, if the two immediate fatalities deemed unpreventable in peer review are excluded, then this critical mortality rate would be 11%. Any death that occurs among survivors who are not critically ill should be analyzed as an important audit filter in assessing the quality of medical management [2]. There were no such deaths in our hospital, and delays in care related to a high volume of walking wounded patients was not evident.

An analysis of the patterns of injury and death from this event corroborates some important principles regarding disaster management. Most survivors had no critical injuries. The high immediate death rate, and the high dead/critically wounded ratio of >2 : 1 (which is in contrast to the 1 : 2 to 1 : 5 that is typical of military combat in conventional wars) was probably because of the extreme magnitude of the explosive force at an indoor location, as observed by others [4].

Many previous assessments of urban mass casualty situations in other parts of the world confirm the recent experience in Madrid. The nearest hospitals are overwhelmed by early arrival of all types of injured victims. Multiply injured survivors are not the rule. Rather, most fatally injured victims die at the scene [2–4,9,14,17]. Nevertheless, given the relatively large number of critical patients triaged to GMUGH, and according to recent recommendations on the subject [18], urban hospitals should be better prepared to respond to these mass casualty situations. As a recent survey among members of a surgical association in the USA [19] demonstrates, the level of preparedness among medical personnel and facilities to cope with large-scale terrorism has many areas of weakness.

In Madrid the bombings occurred shortly before the start of a midweek work day when most clinicians and medical personnel were on their way to work or already at the hospital, and night shifts were still on duty. This, together with empty operating rooms and personnel waiting for the first scheduled cases, proved decisive as regards the adequacy of the medical and surgical response at GMUGH and other hospitals. Had the blasts occurred just 1 hour later, then the whole situation would have been much worse and very difficult to cope with.

Much and probably well deserved praise has been received from many authorities in Spain and abroad, in the aftermath of the attacks, regarding the response of our health system. That notwithstanding, and as others have pointed out in other places and occasions [9], our policy makers must not confuse the community response to a disaster (which has been proven repeatedly in all parts of the world to be a predictably selfless and determined effort from all sides of society) with a fully functional regional trauma system, which we still lack. This functional trauma system requires a determined commitment to education, planning and coordination, financial resources and well staffed hospital emergency services.

Competing interests

The author(s) declare that they have no competing interests.

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