

## Commentary

# Terrorist bombings in Madrid

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The report by Peral Gúterrez de Ceballos and colleagues [1] is a timely, well written, and informative contribution to our growing body of knowledge of disaster medicine, as well as an appalling confirmation of the horrors of the senseless and vicious scourge of terrorism that now afflicts the world. Their comprehensive analysis of the results of medical management of 312 survivors triaged to the Gregorio Marañón University General Hospital (GMUGH) provides several important lessons, and raises several questions, for medical providers around the world who are increasingly faced with the necessity of learning how to plan and implement an effective response to such a daunting challenge.

The authors confirmed the many consistent patterns to be expected following terrorist bombings, which virtually every other published series has documented [2,3]. The great majority of immediate survivors (1789/1885 [95%]) were not critically injured. As the authors state, this is best explained by the selection bias caused by the immediate death of most of those with critical injuries. Although it appears quite favorable that 14 of these 1885 immediate survivors (0.74%) subsequently died, it is important to recognize that this is deceptive because most casualties were not at all at risk for death. The death rate was correctly expressed in this report as a percentage of only the critically injured casualties who were truly at risk for death, and among whom all deaths occurred, resulting in a much heftier 'critical mortality' rate of 17% (14/82). This is a more accurate reflection of the quality of medical care given in such a mass casualty setting, and is a more accurate standard for comparison with other similar bombings. This critical mortality rate falls well within the range of all other terrorist bombing disasters, and lends itself to quality improvement analysis. The authors should be commended for applying the established objective measures of injury severity (Injury Severity Score, Acute Physiology and

Chronic Health Evaluation II) to their patient population to allow this determination. I do agree that the two early emergency room deaths should be included in this figure because these patients were exposed to medical care.

The injury patterns in this event were also typical of bombing disasters. Head, chest, abdominal, traumatic amputation and blast lung injuries predominated among the critically injured survivors, being the most common contributors to death; musculoskeletal and soft tissue wounds predominated among those who were not critically injured. Eardrum perforations and eye injuries were quite common but did not cause life-threatening problems.

Over-triage, or the assignment of noncritically injured victims to immediate medical evaluation and hospitalization, was also predictably and typically high, in view of the large load of casualties with noncritical injuries. At the GMUGH, 91 out of the 312 survivors evaluated (29%) were hospitalized, but 62 of these were not critically injured, yielding a substantial over-triage rate of 68%. The danger with this degree of over-triage is in the potential to overwhelm limited medical resources and prevent that minority with critical injuries from being quickly identified and treated, thus increasing critical mortality. Although the authors did not believe that this interfered with their treatment, their 17.2% critical mortality at this level of over-triage falls well within the linear relationship demonstrated between over-triage and critical mortality [3]. Furthermore, an objective analysis of the deaths may reveal preventable delays in diagnosis and treatment that were not immediately perceived. For instance, one of the deaths was due to a ruptured thoracic aorta in a patient who had been fully evaluated and already admitted to the intensive care unit; could this injury have been identified earlier and repaired, and could it represent an oversight caused by the confusion of sorting out so many noncritical victims? These considerations

emphasize the importance of triage accuracy, and of preventing, as much as possible, the arrival of so many noncritical victims to a definitive care hospital by performing triage first at outside sites before allowing them to inundate the hospital.

The massive response of the public to donate blood following the Madrid bombings is another very typical pattern seen in such disasters. However, it is a very unfortunate response that represents a misguided attempt to help on the part not only of the lay public but also of the medical community and media, and must be curbed in future events. It is well established that very little blood is needed in these disasters; again, only a small minority are critically injured, and only a small percentage of these ever need blood. Following the New York City World Trade Center disaster of 9/11, more than 20,000 units of donated blood had to be discarded unused. This was confirmed by the authors of this paper in reporting only 104 units given to patients out of several thousand donated units. The problem with this is that the hospital can be paralyzed by the crowds lining up to give blood, diverting critically scarce hospital resources and personnel away from those victims who are most in need, leading to potentially unnecessary harm to these victims. This altruistic response of the public should be more effectively channeled to other blood-banking facilities outside hospitals where they will not interfere with triage and treatment of casualties, and the media should be educated to avoid directing the public to such futile activity.

Nonetheless, the outstanding performance of the authors, their coworkers, and the entire city of Madrid in the hours and days following this tragedy must be recognized. There appeared to be a reasonably prompt and effective initial triage and distribution of casualties among all available hospitals by the prehospital first responders, indicated by the fact that GMUGH – the closest facility – was not inundated with the majority of casualties, as has occurred in so many other similar events. The most seriously injured were apparently transported to the most appropriate hospitals with the greatest resources. With virtually no warning, GMUGH performed all of the appropriate procedures to maximize their surge capacity for incoming victims (clearing of emergency room, intensive care unit and floor beds, and canceling all surgery in the operating rooms); this is a valuable lesson, and all hospitals should include such actions in their disaster plans. The absence of any apparent under-triage – deaths due to critical injuries being overlooked and assigned to delayed care – suggests good triage and is quite consistent with the published literature. The high number of blast lung injuries in survivors also suggests rapid evacuation and treatment, and the low mortality (2/17 [12%]) among these survivors indicates excellent intensive care for such very difficult cases. The relatively low immediate death rate of 8.6% (177/2062), as compared with most other terrorist bombings, is certainly due in part to the fact that this was an

open air blast that was rapidly dissipated over a short distance, without any building collapse or shrapnel causing serious penetrating wounds. However, the rapid response, and evacuation and treatment of survivors who otherwise may have died with longer delays could undoubtedly be another contributing factor to this result.

The authors discuss the merits of developing a trauma system in Spain to augment and serve as the basis for disaster readiness on a large scale, a concept that we advocate in the USA [4]. Trauma centers have a ready-made infrastructure in place for disaster responses, including the personnel and resources for managing multiply injured patients in large numbers. They also have most of the necessary liaisons with public health, law enforcement, the media, prehospital services, search and rescue, local government, and transportation assets for evacuation. Most importantly, they have around-the-clock surgical availability. This is essential in those terrorist attacks that are, by far, the most likely to occur if we are to heed history as well as current events, namely bombings and shootings, with bodily injury the most likely result. In fact, a state-wide system has already been implemented on this principle in Connecticut, using the state-wide trauma centers in a coordinated network of function, which serves as a model of what can be done in any region or country [5].

There are several cogent questions that remain unresolved with this report, but only a full analysis of the entire event, looking at the combined experience of all involved hospitals, can answer these. All 14 deaths among the critically injured survivors should be thoroughly analyzed to identify any preventable problems in management that could be improved in future events. Were there any hospitals in Madrid that were not used, which could have helped to lighten the load on the others? If so, then a better system of casualty distribution should be planned. It would be of interest to know how the existing disaster plan of GMUGH, and for the entire city of Madrid, held up through this event. Was it at all helpful? Were any revisions made as a result of this experience to improve the disaster response in the future? It has been recommended by several experts that the closest hospital to the disaster scene, as GMUGH was, should be used as a casualty collection point and initial triage station for distribution of casualties to the other available hospitals, rather than as just another treatment facility, as it was in this event. What led to this decision? What procedures were used to assure security of the hospital and prevent it from being overrun with worried well victims and families, and how was the media handled? These considerations are important points for all of us to learn.

Finally, the authors must be congratulated for their foresight and commitment in performing the huge but essential task of putting together all these data and submitting a report for publication so that the rest of the world can learn from their

valuable experience. Unlike most of medicine, true mass casualty disasters are very rare, and approaches to planning and management are very different from our everyday practice. Therefore, most of us will never learn how to deal with such incidents, and the same mistakes will be repeated each time unless we take to heart the experiences of those who have been confronted with a disaster. With the wealth of published experience now available to us, which this reports nicely augments, it is clear that there are definite patterns of injury, behavior, and impediments to care that follow all terrorist bombings, and – to a great extent – disasters of all kinds as well. Once patterns are identified, there is opportunity to plan and cope, and discard the notion that these are acts of God that cannot be predicted or planned for. The biggest barrier to effective learning now is the apathy and complacency that plagues so much of our medical community, precisely because of the rarity of these events. We must all become involved in disaster planning at our own hospitals and in our own communities, and contribute to the education and motivation of our colleagues if success is to be achieved.

### Competing interests

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

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