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Air Medical Journal

journal homepage: <http://www.airmedicaljournal.com/>

Critical Care Update

Faces of Terrorism

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It is convenient to label civilian mass casualty situations or terrorism as it now approaches our neighborhoods as a larger example of civilian interpersonal conflict or an assault on our military moved to the homeland. Unfortunately, neither of these impressions is true. Terrorism strikes in different and more severe ways. New management strategies reflecting a knowledge of terrorism or multicasualty events in the civilian setting are necessary. Although lessons learned from recent military conflicts have unquestioned value, additional insight, resuscitation principles, and tools are needed.

Definitions of Terrorism: Quiet and Catastrophe

Haug CJ. Report from Paris. *N Engl J Med*. 2015; 373:2589-2593.

Shultz JM, Thoresen S, Galea S. The Las Vegas shootings—underscoring key features of the firearm epidemic. *JAMA*. 2017;318:1753-1754.

A leader in the emergency department (ED) of the Hôpital Saint Louis in Paris provides an elegant discussion of the presentation and implications of multicasualty terrorism as seen from a receiving hospital. His report notes that in the evening a provider ran into the ED shouting that there was a shooting near the hospital and that a stretcher was required. Details could not be gleaned from this report. Anxiety obscured any further information.

Ultimately, the request boiled down to a stretcher, which was released. Subsequently, neighbors brought in victims from multiple shootings. The second victim came on the

requested stretcher. After that, victims came from cars, stretchers, and with assistance from family members. One of the first patients did not know that he had been shot. The patient did acknowledge pain and that he could not walk. On initial examination, the patient had two bullet wounds with one in the back and one in the leg. The second injured patient presenting in this ED was a grandmother who had been leaning over her grandson to protect him. As patients continued to arrive, emergency physicians realized that something unusual was happening, but they did not know what at the time. This French report emphasized that there was no early information.

As other ED staff arrived, the first impression was silence. Consistent reports of casualties led staff to quickly report to the ED with the expectation that there would be shouts, crying, and blood. Blood was present, and patients were everywhere on stretchers. Some of the patients were critically ill. Many were the “walking wounded.” Remarkably, there was no information, no panic, and little noise. Over time, fresh inpatient staff arrived, and operating rooms were prepared. Surgeons and senior ED personnel provided triage services and aligned patients with needed resources. Surrounding hospitals with available capacity were also contacted. Within hours, the flow of the wounded and identification of the dead were largely complete.

The next challenge was apparent by the following day. Psychological trauma of the victims, their families, and individuals who had witnessed the events of the previous evening had to be addressed. The French Emergency System for Psychological Care was mobilized within hours. Five locations for victims of emotional trauma were set up as the breadth of catastrophe became

clearer. A pool of emergency health workers was identified to match resources to parts of the psychosocial support system that were overwhelmed or experiencing a sudden surge in patient demand. Within a day, much of this work was focused on medical and psychological aid for traumatized families and help in identifying bodies. Terrorism brings dimensions of stress on a health care and social system requiring a resilient plan for medical and psychological care. In addition to unique patterns of injury, terrorism is a public health challenge.

Patterns of Penetrating Trauma: Stabbing

Rozenfeld M, Givon A, Peleg K. Violence-related versus terror-related stabbings: Significant differences in injury characteristics. *Ann Surg*. 2018;267:965-970.

Peleg K, Jaffe DH, Israel Trauma Group. Are injuries from terror and war similar? A comparison study of civilians and soldiers. *Ann Surg*. 2010;252:363-369.

Victims of terrorist stabbings sustain injuries with a different profile and greater severity, require more hospital resources, and have worse clinical outcomes than patients who are stabbed as a part of an interpersonal conflict. A detailed report from the Knife Intifada, which lasted from early 2013 to March 2016, provides data for a fascinating Israeli article. For example, patients stabbed in the setting of terrorism tended to sustain injury in the middle of the week as opposed to victims of interpersonal violence in whom injury was seen on the weekends. Morning and noon hours were high-risk time intervals for terror attacks, whereas the night risk was significantly higher for nonterror stabbing.

Injuries sustained by patients having interpersonal conflict as opposed to victims of terrorism were different. Chest injuries were important in both groups, but the proportion of severe chest injuries was significantly higher in the terrorism victims. Overall, the volume of abdomen injuries was substantially higher after interpersonal conflict; however, severe abdominal injuries were much more common in the setting of terrorism. Patients who were victims of stabbing with terrorism had more frequent and severe injuries of the head, face, and neck. The volume of spine injuries and wounds to upper extremities resulting from terrorism by stabbing was also significantly higher. Only in the lower extremities was a similar proportion of injuries found in victims of terrorism and those of interpersonal violence.

Although victims of stabbing in terrorism had more injuries overall, they were also more likely to arrive with unstable vital signs and a lower Revised Trauma Score and Glasgow Coma Scale score. The need for blood transfusion in victims of terrorism was higher. When the severity of injuries to major body regions affecting survival (head, neck, chest, and abdomen) was analyzed among patients with injuries to those areas, the real difference between interpersonal violence and terrorist stabbing became more distinct. The likelihood of severe chest stab wounds in terrorism was 3-fold higher than with interpersonal civilian conflict. The chance of poor outcome in abdominal stab wounds was 4-fold greater in the victims of terrorism. Significant head injury was also more common with stabbing secondary to a terrorist event.

A difference in the two patient groups was also identified from the standpoint of the use of hospital resources and subsequent outcomes. More than half of the terrorism victims required surgery compared with one third of the victims of stabbing associated with interpersonal violence. The most frequent type of surgery for patients with interpersonal civilian violence was exploratory laparotomy, whereas victims of terrorism required a high volume of chest and musculoskeletal procedures. The need for spine, head, eye, ear, nose, and throat procedures was also significantly higher for victims of terrorism. The likelihood of intensive care unit placement during hospitalization was 3-fold greater in the victims of stabbing associated with terrorism. The requirement for imaging was significantly higher for patients sustaining stab wounds as a part of terrorism.

The general intention of terrorists is death rather than wounding or threatening their victims. Thus, the pattern of injury commonly seen in terrorism is associated

with the overhand grip used to thrust downward with a knife at a right angle to the arm. On the other hand, many victims of interpersonal violence sustain trauma from a less powerful underhand grip. Descending from the overhand position, the knife of a terrorist will most likely strike the upper thorax, head, and neck, while the underhand attack in civilian conflict is directed toward the abdomen. Biomechanical studies show that the downward thrust of a terrorist assault generates greater power and knives have been shown to strike with sufficient force to penetrate bone and cartilage. Previous Israeli studies also identify the greater length of knives used in terrorism and employment of blades with greater penetrating power.

Patterns of Penetrating Trauma: Mass Shooting

Smith ER, Shapiro G, Sarani B. The profile of wounding in civilian public mass shooting fatalities. *J Trauma Acute Care Surg.* 2016;81:86-92.

Butler FK. Military history of increasing survival: the U.S. military experience with tourniquets and hemostatic dressings in the Afghanistan and Iraq conflicts. *Bull Am Coll Surg.* 2015;100:60-64.

de Jager E, Goralnick E, McCarty JC, et al. Lethality of civilian active shooter incidents with and without semiautomatic rifles in the United States. *JAMA.* 2018; 320:1034-1035.

With the incidence and severity of public mass shootings continuing to rise, there is increasing focus on improving survival for the wounded from active shooter events. Much of the public work has been associated with messaging on external hemorrhage control with particular emphasis on the use of extremity tourniquets. Emphasis on extremity tourniquets is driven by military wound patterns and other lessons learned from recent Middle East conflicts. However, there must be evidence that supports the premise that civilian and military wound patterns are similar.

The examination of autopsy results obtained from mass shooting fatalities revealed wounds on each fatality ranging from 1 to 10 in number with an average of 2.7 wounds per victim. The overall anatomic wounding pattern, including both fatal and nonfatal wounds, showed that the head and chest or upper back were the anatomic regions most frequently involved in mass casualty shootings because 58% of victims had at least one wound to the head and/or

chest and upper back. Only 20% of wounds overall in mass shootings were to the extremity region; 13.5% of wounds were in the abdomen or lower back regions, also confirming that shooters aimed at the torso and their intention was to kill. Fifty-six percent of victims of mass shootings had wounds to more than one anatomic region. Further examination of civilian casualties of mass shooting incidents revealed that the majority of fatal wounds were to the head or chest and upper back. No extremity wounds were identified that would have resulted in acute exsanguination and death. The vast majority of patients killed in civilian mass casualty gunshot assaults were felt to have nonsurvivable injuries, yielding a potentially survivable rate of only 7%. The most common potentially survivable injury in the mass casualty gunshot group was injury to the chest from a shotgun. In general, these wounds did not contain pathologic findings suggesting immediate risk of death caused by respiratory embarrassment.

Although the physiology of ballistic wounding and the resulting systemic physiologic response is the same between civilian and military trauma, almost every other aspect of combat and civilian events is different. Directed medical interventions after a mass shooter incident require alteration in strategy and therapeutic emphasis to decrease the number of potentially preventable deaths.

There are a number of reasons why military lessons cannot be applied in a direct manner to civilian mass casualty situations. First, explosive events are more common in the military setting. The vast majority of combat injuries associated with fatality came from blast and fragmentation insults rather than gunshot wounds. Blast, burns, and fragmentation injury generally are not seen in civilian mass casualty settings. The majority of injuries in combat are to the extremities, whereas far less civilian injury included trauma to the limbs. Civilians suffering from a mass casualty shooting incident had a much higher percentage of head and torso injury compared with military casualties, possibly related to the body armor worn by military personnel as well as the differing mechanism of injury. In addition, the shooter in civilian mass casualty situations is, for the most part, much closer to the victim than the enemy combatant is from the soldier. The smaller distance in civilian settings improves the accuracy and ability for the shooter to hit center mass and create a higher incidence of head and torso injuries. Soldiers have a higher percentage of significant injury in multiple anatomic sites. The presence of multiple anatomic sites of injury reflects the prevalence of blast as a mechanism of trauma in the military.

Civilian mass shootings overall are more lethal events with a higher case fatality rate than experienced in military combat. The case fatality rate for active shooting events reported in the civilian population is more than 4 times that identified in military injury. As noted previously, autopsies of victims from civilian mass shooting incidents showed exsanguinating extremity hemorrhage was not an important cause of death. Tourniquets and simple hemorrhage control measures have a role in improving survival but no longer should be the primary focus of first responders to civilian mass shootings and related public education. Chest injury, by far, predominates as the most common potentially survivable wound in the civilian setting and a systematic approach that promotes hemorrhage control, and the entire spectrum of emergency casualty care must be adjusted to reflect this reality. Thus, medical care in the wake of a civilian mass shooting must include strategies to prevent secondary injury, provide airway management, identify declining respiratory function, optimize movement of the casualty, and prevent hypothermia. Another research review highlights the increased morbidity and mortality experienced by victims from active shooter incidents when semiautomatic rifles were used.

Explosive Injury

Rozenfeld M, Givon A, Shenhar G, et al. A new paradigm of injuries from terrorist explosions as a function of explosion setting type. *Ann Surg.* 2016;263:1228-1234.

DePalma RG, Burris DG, Champion HR, Hodgson MJ. Blast injuries. *N Engl J Med.* 2005;352:1335-1342.

Explosions resulting from terrorist activity require a rapid coordinated response from the health care team in what are often chaotic circumstances. Careful preparation, both before and immediately after such an event, is crucial to help hospitals effectively respond. The location of events has been important in historic data. For example, bus explosions have previously received

significant attention because of high lethality and resulting injuries. The Israelis have gathered more recent information regarding terrorist explosions occurring in that country in the initial years of the Second Intifada. These Israeli data suggest that explosions occurring in confined spaces do not necessarily increase primary blast trauma. For example, ear and lung injuries were found to be dominant inside buses but not inside buildings. Differences in the type of confinement with varied wall materials, ceiling heights, and density of victims may affect outcomes. For example, higher lethality was identified during bombing incidents targeting subjects standing in line to get into a building. Victims already inside a building actually had a lower incidence of blast trauma. Victims from confined space bombings (buildings and buses) had a higher proportion of burns. This suggests that containment by four walls is consistent with increasing the effect of a fireball produced by explosion and resulting high temperatures. Treatment of burns related to blast injuries is an important problem and is extremely resource intensive.

In terms of the balance between penetrating and blunt injury secondary to explosions, the type of enclosure appeared to have relatively little influence; explosions inside buses almost exactly matched those of open space scenarios, whereas explosions inside buildings were similar to those in semiopen spaces. With respect to severe injury (Injury Severity Score > 16) the setting of injury forms a hierarchy based on the enclosure type. Explosions occurring within a building left 45% of patients with severe wounding. An explosion occurring within a bus was associated with 39% of victims with severe wounding. Victims adjacent to a building sustained a 32% rate of severe injury, whereas patients in the open sustained a 27% incidence of severe injury. Finally, individuals not inside but adjacent to a bus had a severe injury rate of 16%. The differences in the severity of injury sustained in explosions at different settings were matched by the quantity of hospital resources needed to treat those injuries. Patients injured in higher-risk scenarios required more operative interventions and

increased intensive care unit resource use and had longer hospitalization.

Summary Points

- The presentation of terrorism does not always follow the stereotype established in community plans or found in the popular media. The presence of mass casualties because of terrorism may only slowly become apparent, and dramatic presentation may be absent.
- The pattern of stabbing injury can be dramatic in the setting of terrorism with emphasis on injury to the head, neck, and upper torso. This type of trauma, plus the technique of stabbing, increases lethality in comparison with civilian stab wounds.
- Gunshot injuries associated with a mass casualty situation or terrorism again emphasize injury to the head, neck, and upper torso. Although military trauma emphasizes injury to extremities and early placement of tourniquets can be lifesaving, this type of strategy may not be effective in the scenario of multiple gunshot wounds from a mass casualty event.
- Historic Israeli data suggest that terrorism by explosive agents is more common in closed spaces such as buildings and buses. More recent data from the Israelis confirm the importance of being in a closed space with injury associated with explosion. However, victims adjacent to a building and individuals in open spaces also have significant risk for severe trauma.

Acknowledgments

The author gratefully acknowledges the assistance of Ms. Sherry Willett in preparation of this series for *Air Medical Journal*.

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