Abstract:
This article is part of a collaborative effort by experts in the field of emergency preparedness to complete an overview begun by the late Michael Shannon, MD, MPH, on the current challenges and future directions in pediatric disaster readiness. This particular article, "Preparation for Terrorist Threats: Explosive Devices," will promote a greater awareness of explosive devices as significant terrorism threat and pertinent clinical considerations in caring for pediatric victims of explosive injury.

Preparation for Terrorist Threats: Explosive Devices

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Although most attention regarding all-hazards preparedness has been focused on bioterrorism and natural disasters, it is important to note that bombs and explosives have been the weapons most commonly used by terrorists. Most physicians and other health care providers, as well as the public, are unfamiliar with many of the features of terrorism resulting from the use of such weapons of destruction.

Indeed, there is a need for greater emphasis on preventing terrorist assaults that use explosives. This should be part of a continuum that includes preparing for, responding to, and recovering from such events. This should include the injuries that are likely to be caused by explosives as well as their devastating psychologic effects, with attention to the special needs of children.

As a result of lessons learned from recent disasters involving terrorists and explosives, planning considerations should include the development of a network containing multiple hospitals so that those closest to the event are not overwhelmed. After the bombings of the Murrah Federal Building in 1995 and the Madrid trains in 2004, most victims were taken to the nearest hospital.[1-3] Because the number of casualties that required medical management rose into the hundreds, certain facilities were overwhelmed, and the care provided became inefficient and delayed. Therefore, a plan that includes multiple hospitals in the response system is needed in the event of a terrorist bombing attack as we must be prepared to care for multiple victims.

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Even though suicide bombing has occurred in other countries, the potential for such an event in the United States needs to be seriously addressed. First, responders and physicians must become familiar with the nature of the injuries inflicted by explosions. There will likely be victims who experience burns, crushed bones, ruptured eardrums and intestines, and penetrating injury from nails and other projectiles that were packed with the explosives. This characteristic is unique to terrorist bombing in that other acts of violence rarely produce combinations of such wounds in a single individual.[4]

Explosions, particularly in confined spaces, have the capability to cause multisystem, life-threatening injuries in single or multiple victims simultaneously, presenting complex triage, diagnostic, and management challenges for the health care provider. Blasts produce classic injury patterns from blunt and penetrating mechanisms to several organ systems. Children are particularly at risk for blast injury because of their size and susceptibility to head and abdominal trauma. The blast wave, flying debris, and injuries from being thrown may have more deadly results in children. Understanding these crucial differences is critical towards effective management.

Though the occurrence of bombings in the United States has been infrequent, when such incidents do occur, cases tend to be clustered and have the ability to temporarily overwhelm a local health care system.[5,6] Because many patients will self-evacuate after a terrorist attack and prehospital care may be difficult to coordinate, hospitals near the scene can expect to receive a large influx of victims after an event. This rapid surge of victims typically occurs within minutes as exemplified by the Madrid bombings where the closest hospital received 272 patients in 2.5 hours.[1] Health care and public health specialists anticipate profound problems in adequately caring for the resulting surge of victims.[7,8] Our current health care system, especially our emergency care system, is already strained attending to routine daily patient volumes. There are a total of 170 verified pediatric trauma centers, located in 41 states (including the District of Columbia).[9] An estimated 70% of children younger than 15 years reside within 60 minutes of one of the centers by ground or by air transportation, whereas nearly half are within 60 minutes if only ground transportation was considered. This leaves an estimated 17.4 million US children (one third) who would not have access to a pediatric trauma center within 60 minutes, an amount of time that could prove deadly in the event of a serious injury.[9] Access also varies by state, ranging from more than 90% of children having access in 11 states to less than 25% having access in 12 states. After a bomb blast, health care personnel with limited trauma care expertise and little or no pediatric experience could be called upon to treat critically injured children.[9,10]

Because blast terrorism in recent years has involved children, significant experience has been gained in understanding the consequences of blast injuries. These experiences highlight a number of vitally important issues regarding blast terrorism mitigation in children.[5,6,11-15]

- After a blast, most children will be injured in closed or confined spaces, which greatly increase the magnitude of forces of injury.
- As with blast injuries in adults, most children will either die at the scene or sustain minor injuries. Only a small number of children in the penumbra of the blast wind who sustain major injuries will survive to require hospital care, but typically, they will not begin to arrive at the trauma center until 30 to 60 minutes after the blast event.

Most surviving children with major injuries will require early surgery and subsequent care in a pediatric critical care unit, followed by lengthy hospitalization and rehabilitation, both physical and psychologic. The United States has 4919 community hospitals, of which approximately 250 are children's hospitals, representing approximately 5% of our nation's hospitals. The number of hospitals that are truly capable of providing care to critically ill and injured children is relative small. Most pediatric critical care units have a limited number of trained, available, and experienced staff.[15-19] Many of our nation's hospitals with large pediatric emergency and critical care units already operate at near maximum capacity. If a mass casualty involving children and infants were to occur, the immediate ability to provide pediatric emergency and/or critical care would be severely constrained. A recent Centers for Disease Control and Prevention publication determined that approximately three fourths of hospitals had disaster plans that addressed explosives, but few (one fifth) had actually conducted a drill that involved imagined use of explosives. Continual education combined with regularly scheduled disaster drills are needed to train response and hospital personnel in the triage and management of victims due to bombings.[2,6,7,18]

One of the most prevalent problems that will be experienced by both adults and children will be the

assessment and effective treatment of the mental health concerns induced by terrorism. For example, although survivors of an automobile accident may benefit from group therapy, group interaction after a terrorist incident could heighten emotional turmoil. Disaster survivors and others affected by such events will experience a broad range of early and late reactions (eg, physical, psychologic, behavioral, and spiritual). Some of these reactions will cause enough distress to interfere with adaptive coping, and recovery may be helped by support from compassionate and caring disaster responders as well as ongoing mental health interventions after the event.[20,21]

BOMBS IN OUR SCHOOLS—A REALITY HERE TO STAY

In an era of rapidly growing technology and instantaneous worldwide communication, it is no surprise that there are countless Web sites describing how to make a bomb in the home or how to construct a bomb specifically to blow up a school. In addition, there are hundreds of violent video games available online to anyone using the Web. Columbine and Oklahoma City are constant reminders that the threat of a bomb explosion in our schools is real. The size of the community and the demographics of the school make little difference.[21-23]

Schools should be a safe haven for our children but are most vulnerable to a bomb attack. Schools and families must be informed and prepared for such an event. Students at all levels must be taught to report immediately any suspicious behavior by fellow students and strangers. Students must also be taught how to react in the event of a disaster, both "natural" (fire, storm) and man-made (bomb scare, explosion). Students must learn how to take cover, how to assist others, and how, if possible, to use their cell phones to call for help. Parents should talk to their children about the possibilities of a disaster that could occur while they are at school and how to care for themselves. These discussions should be part of a broader plan for family emergency preparedness.

In addition, parents should monitor their child's behavior. If parents notice a change in behavior and/or lack of communication, they should intervene immediately. Talking with one's child and taking adequate time to do so may make a real difference. In Columbine, the student bombers voiced to fellow students before the bombing that they felt alone and on the outside. Greater awareness of this expression of social isolation may have afforded an opportunity to prevent that tragedy.

At the Columbine School Memorial in Littleton, CO, there is a plaque from a faculty member on the stone wall of the memorial that reads: "They never taught us in school how to deal with a tragedy like this." Faculty and administrators bear a huge responsibility from parents and guardians to watch over their children. It is important for parents to advocate for their children to partner with faculty, staff, and administrators in monitoring for any concerning behaviors of students and others within the school environment. As should occur within the family unit, faculty and administrators need to discuss with students how to prepare for and react to the possibility of an emergency, such as a bomb explosion, in the school. Schools must have well-developed emergency plans that must be actively practiced, at a minimum annually. Emergency preparedness and response should be part of all faculty development programs held at the beginning of each school year.[24-26]

A 2006 study by the US Secret Service concluded that schools were taking false hope in their physical security. The report stated that schools should be paying more attention to the preattack behaviors of everyone in the school, especially students. With the physical security measures taken by most schools today, most bomb attacks will be well calculated. See-through backpacks, metal detectors, computer-generated IDs, and security guards have helped to make our schools safer, but more needs to be done in preparedness training, drills, and, above all, communication with families and within the school to better target those that might have behavioral or psychologic disorders. The greatest security challenge will continue to be with attacks from outsiders or terrorists.[21]

Schools remain a safe haven for children, but we must now include safety and preparedness planning, training, and exercising at all levels. Bombs and blasts in our schools will always be a threat, but we can help to minimize the risks and ultimate losses. ✚

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