

Ocular Blast Injuries in Mass-Casualty Incidents

The Marathon Bombing in Boston, Massachusetts, and the Fertilizer Plant Explosion in West, Texas

Yoshihiro Yonekawa, MD,^{1,2,3,4,5} Henry D. Hacker, MD,⁶ Roy E. Lehman, MD,⁶ Casey J. Beal, MD,⁷ Peter B. Veldman, MD,^{1,4,5} Neil M. Vyas, MD,⁸ Ankoor S. Shah, MD, PhD,^{1,3,4,5} David Wu, MD, PhD,^{1,4,5} Dean Elliott, MD,^{1,4,5} Matthew F. Gardiner, MD,^{1,5} Mark C. Kuperwaser, MD,² Robert H. Rosa, Jr., MD,⁶ Jean E. Ramsey, MD, MPH,⁸ Joan W. Miller, MD,^{1,4,5} Robert A. Mazzoli, MD,^{9,10} Mary G. Lawrence, MD,¹⁰ Jorge G. Arroyo, MD, MPH²

Purpose: To report the ocular injuries sustained by survivors of the April 15, 2013, Boston Marathon bombing and the April 17, 2013, fertilizer plant explosion in West, Texas.

Design: Multicenter, cross-sectional, retrospective, comparative case series.

Participants: Seventy-two eyes of 36 patients treated at 12 institutions were included in the study.

Methods: Ocular and systemic trauma data were collected from medical records.

Main Outcome Measures: Types and severity of ocular and systemic trauma and associations with mechanisms of injury.

Results: In the Boston cohort, 164 of 264 casualties were transported to level 1 trauma centers, and 22 (13.4%) required ophthalmology consultations. In the West cohort, 218 of 263 total casualties were transported to participating centers, of which 14 (6.4%) required ophthalmology consultations. Boston had significantly shorter mean distances to treating facilities (1.6 miles vs. 53.6 miles; $P = 0.004$). Overall, rigid eye shields were more likely not to have been provided than to have been provided on the scene ($P < 0.001$). Isolated upper body and facial wounds were more common in West largely because of shattered windows (75.0% vs. 13.6%; $P = 0.001$), resulting in more open-globe injuries (42.9% vs. 4.5%; $P = 0.008$). Patients in Boston sustained more lower extremity injuries because of the ground-level bomb. Overall, 27.8% of consultations were called from emergency rooms, whereas the rest occurred afterward. Challenges in logistics and communications were identified.

Conclusions: Ocular injuries are common and potentially blinding in mass-casualty incidents. Systemic and ocular polytrauma is the rule in terrorism, whereas isolated ocular injuries are more common in other calamities. Key lessons learned included educating the public to stay away from windows during disasters, promoting use of rigid eye shields by first responders, the importance of reliable communications, deepening the ophthalmology call algorithm, the significance of visual incapacitation resulting from loss of spectacles, improving the rate of early detection of ocular injuries in emergency departments, and integrating ophthalmology services into trauma teams as well as maintaining a voice in hospital-wide and community-based disaster planning. *Ophthalmology* 2014; ■:1–7 © 2014 by the American Academy of Ophthalmology.



Supplemental material is available at www.aaojournal.org.

On April 15, 2013, 2 improvised explosive devices (IEDs) were detonated 13 seconds apart at 2:49 PM near the Boylston Street finish line of the 117th Boston Marathon.¹ Improvised explosive devices are homemade bombs created and detonated outside of conventional military use, commonly used in terrorist attacks and guerrilla warfare. Mass-casualty incidents caused by IEDs are rare in the United States civilian setting. Two hundred sixty-four runners and spectators sustained injuries during the Boston bombing, and 3 died at the scene.² The marathon was halted, medical tents were converted to mass-casualty triage units, and emergency medical services (EMS) transported the victims to nearby adult and pediatric trauma centers.

Two days later, on April 17 at 7:50 PM, an ammonium nitrate explosion at a fertilizer plant in West, Texas, injured 263 and killed 15 people.³ A fire preceded the explosion, which resulted in: (1) the most severe injuries occurring in the first responders who were attending the fire, resulting in incapacitation of the primary EMS teams; and (2) a preponderance of glass shard injuries to locals who were observing the fire from behind windows at the time of the explosion. Neighboring emergency services were mobilized and transported the victims to hospitals, but the closest healthcare facility was 25 miles away.

The 2 mass-casualty tragedies occurred 52 hours apart and resulted in similar numbers of injuries, but with

different mechanisms, geographic settings, and local medical response networks. The Boston Marathon bombing was an intentional, planned, and relatively low-energy explosion that took place in a densely populated urban center, but with numerous level 1 trauma centers within a 2-mile radius. The West incident was a high-energy, accidental open-field explosion in a relatively rural setting. Both blasts caused severe ocular injuries and provide valuable lessons for both ophthalmic and trauma communities in disaster readiness and response planning. As the ophthalmic consultants for the 2 tragic incidents, we report and discuss the ocular injuries sustained by the survivors and the insight gained by ophthalmologists involved in these events.

Methods

This study was a multicenter, cross-sectional, retrospective, comparative case series of victims of the Boston Marathon bombing on April 15, 2013, and the West fertilizer plant explosion on April 17, 2013. For the Boston cohort, patients were identified from inpatient or emergency department consultation records at the Beth Israel Deaconess Medical Center, Boston Children's Hospital, Boston Medical Center, Brigham and Women's Hospital, Massachusetts General Hospital, and Massachusetts Eye and Ear Infirmary. Tufts Medical Center is not included in the study because ophthalmology consultations were not required, but the number of patients transported to Tufts is included in the denominator of total casualties. For the West cohort, patients were identified from consultation and billing records from Children's Medical Center of Dallas, Hillcrest Baptist Medical Center, McLane Children's Hospital, Parkland Hospital, Providence Health Center, and Scott & White Memorial Hospital. Excluded were ophthalmology consultations that occurred during the bombing or explosion for patients unrelated directly to the events. Also excluded were ocular injuries seen only by emergency department personnel without ophthalmology consultations. Distances between incident sites and hospitals were determined using Google Maps (www.maps.google.com; retrieved January 21, 2014). Data collection of demographics was kept to a minimum to assure the confidentiality of patient identification (for example, patients were reported as adult or pediatric with no specified age, gender, or ethnicity, and systemic injuries were recorded intentionally without laterality). Presenting visual acuity, provision of rigid eye shields, ocular injuries, treatment provided, and associated systemic injuries were noted. For the Boston cohort, we also noted whether the patients were runners or spectators, and for the West cohort, whether the patients were outdoors or indoors at the time of injury. Categorical variables were analyzed using the Fisher exact test, and the Mann-Whitney *U* test was used to compare nonparametric continuous variables. The binomial test was used to test proportions. Statistical tests were 2-tailed and significance was defined as $P < 0.05$. Statistical analysis was performed using Stata software version 9.0 (StataCorp, LP, College Station, TX). The institutional review boards of each institution approved the study, except for Providence Hospital, which opted to approve the study as part of a quality improvement initiative. This study complied with the Health Insurance Portability and Accountability Act of 1996 and conformed to the tenets of the Declaration of Helsinki.

Results

Boston Marathon Bombing

The distances from the first IED detonation site to the respective institutions are shown in Table 1. The 2 IEDs injured 264 people,²

Table 1. Distance from Mass Casualty Site to Treating Facilities

Boston Marathon Bombing	Miles	West Fertilizer Plant Explosion	Miles
Massachusetts Eye and Ear	1.3	Hillcrest Baptist Medical Center	24.6
Boston Medical Center	1.3	Providence Health Center	26.2
Massachusetts General Hospital	1.4	Scott & White Memorial Hospital	55.9
Beth Israel Medical Center	1.8	McLane Children's Hospital	57.5
Boston Children's Hospital	1.8	Children's Medical Center of Dallas	78.0
Brigham and Women's Hospital	1.9	Parkland Hospital	79.6
Mean (SD)*	1.6 (0.3)	Mean (SD)*	53.6 (24.0)

SD = standard deviation.

* $P = 0.004$.

with 164 transported to surrounding level 1 trauma centers.^{1,2} Three victims did not survive the blasts and were pronounced dead on the scene.² All patients transported to trauma centers survived, including 19 who were critically injured.^{4,5} Twenty-two patients (13.4%) required ophthalmology consultations that were requested from emergency rooms, during trauma or orthopaedic surgeries, or after surgery in intensive care units or inpatient floors. Twenty-one patients (95.5%) were spectators and 1 was a runner. No patients were provided with rigid eye shields at the point of injury.

Fourteen (63.6%) consultations were requested from the operating room or intensive care units, during or immediately after life-sustaining interventions, whereas only 3 (13.6%) were requested from the emergency room (Table 2). Periocular injuries were seen in 19 patients (86.4%), conjunctival or corneal injuries were seen in 13 patients (59.1%), posterior segment injuries were seen in 3 patients (13.6%), and an open-globe injury was seen in 1 patient (4.5%; Fig 1, available at www.aaojournal.org). Lodged ocular or intracranial foreign bodies were found in 6 patients (27.3%). All ocular and systemic foreign bodies were shrapnel, such as BB pellets and nails. Of 20 patients with ocular injuries, 19 (95.0%) had bilateral injuries and 12 (60.0%) had ocular polytrauma (multiple ocular injuries).

One hundred percent of patients had concomitant systemic injuries. Of note, 18 patients (81.8%) had lower limb injuries, of which 16 patients (72.7%) required surgical interventions. In comparison, head and neck or upper extremity injuries were found in 13 patients (59.1%), of which only 3 such cases occurred in isolation without lower extremity injuries. Burns involving the periocular region were found in 17 patients (77.3%), and tympanic membrane perforations were diagnosed in 11 patients (50.0%) during this acute setting.

West Fertilizer Plant Explosion

The distances from the fertilizer plant to the respective treating institutions are listed in Table 1. A total of 263 injured patients were treated at local and regional hospitals; 45 were seen at Hill Regional and John Peter Smith Hospitals, which did not take part in the current study. There were 15 reported deaths.⁵ Of the 218 patients from the participating institutions, 14 (6.4%) required ophthalmology consultations and are summarized in Table 3. There were 17 other patients with presumed ocular injuries triaged and treated by emergency departments and coded as superficial corneal injuries who were excluded from our analysis. The ocular injury rate increased to 14.2% if these patients were included.

Download English Version:

<https://daneshyari.com/en/article/6200528>

Download Persian Version:

<https://daneshyari.com/article/6200528>

[Daneshyari.com](https://daneshyari.com)