

RESEARCH

Regional Health System Response to the Virginia Tech Mass Casualty Incident

Lisa Kaplowitz, MD, MSHA, Morris Reece, MHA, Jody Henry Hershey, MD, MPH, Carol M. Gilbert, MD, and Italo Subbarao, DO, MBA

ABSTRACT

Background: On April 16, 2007 a mass shooting occurred on the campus of Virginia Polytechnic Institute and State University (Virginia Tech). Due to both distance and weather, air transport of the injured directly to a level 1 trauma center was not possible. The injured received all of their care or were initially stabilized at 3 primary hospitals that either had a level 3 trauma center designation or no trauma center designation.

Methods: This article is a retrospective analysis of the regional health system (prehospital, hospital, regional hospital emergency operations center, and public health local and state) response. Data records from all of the regional responding emergency medical services, hospitals, and coordinating services were reviewed and analyzed. Records for all 26 patients were reviewed and analyzed using triage designations, injury severity scores (ISS), and critical mortality.

Results: Twenty-five of the 26 patients were triaged in the field. Excluding 1 patient (asthma), the average ISS for victims presenting was 8.2. Twelve patients had an ISS of ≥ 9 , and 5 had an ISS score of ≥ 15 . Ten of the 26 patients (38%) required urgent intervention and surgery in the first 24 hours. The overall regional health system mortality of victims received was 3.8% (1 death [excluding 1 dead on arrival {DOA}]/ 26 victims from scene). The regional health system critical mortality rate (excluding 1 victim who was DOA) was 20% (1/5).

Discussion: The outcomes of the Virginia Tech mass casualty incident, as evidenced by the low overall regional health system mortality of victims received at 3.8% (1/26) and low critical mortality rate (excluding 1 victim who was DOA) of 20%, coupled with a need to treat a significant amount of moderately injured victims 46% (12/26 with ISS ≥ 9) gives credence to the successful response. The successful response occurred as a consequence of regional collaborative planning, training, and exercising, which resulted not only in increased expertise and improved communications but also in essential relationships and a sense of trust forged among all of the responders. (*Disaster Med Public Health Preparedness*. 2007;1(Suppl 1):S9–S13)

Key Words: Virginia Tech, mass casualty incident, health system response, trauma, critical mortality, triage

On April 16, 2007 a shooting incident occurred on the campus of Virginia Polytechnic Institute and State University (Virginia Tech). The shooter, a student at Virginia Tech, entered at least 2 campus buildings and in rapid succession killed 33 students and faculty, including himself, and injured an additional 26 people. This article describes the regional health system response to these events that was developed through a collaborative effort of regional hospitals and emergency medical services, local and state public health entities, and the regional hospital coordination entity.

Blacksburg is a relatively small community in a rural area of Virginia. The population of Blacksburg is 39,130 (as of July 2005), including the student pop-

ulation of Virginia Tech, with more than 25,000. The closest level 1 trauma center is Carilion Medical Center (CMCR) in Roanoke, which is located 42 miles from Blacksburg. The next closest level 1 center is at the University of Virginia Health System in Charlottesville, 149 miles from the event scene. The hospitals located closest to the Virginia Tech campus were Montgomery Regional Hospital (MRH), Carilion New River Valley Medical Center (CNRV), Lewis Gale Medical Center (LGH), and Pulaski Medical Center (which did not receive any casualties).

Due to both distance and weather (wind gusts of 60 mph), air transport of the injured directly to a level 1 trauma center was not possible.¹ The injured received all of their care or were initially stabilized

at level 3 trauma centers or at hospitals without a trauma center designation.

METHODS

This article is a retrospective analysis of the regional health system (prehospital, hospital, regional hospital emergency operations center, and local and state public health) response. Data records from all of the regional responding emergency medical services, hospitals and coordinating services were reviewed and analyzed. Records for all 26 patients were collected. Hospital records of the 3 primary hospitals (MRH, CNRV, LGH) and one level 1 referral hospital (CMCR) were obtained. An injury severity score (ISS) was determined for each case presenting.² Critical mortality as defined as the number of deaths in critically injured survivors was calculated (ISS scores of ≥ 15).^{3,4} It should be noted that none of the hospitals primarily receiving the patients was a level 1 center and in fact were level 3 or nondesignated.

RESULTS

The following is a brief description of the events that occurred on the Virginia Tech campus, as reported by the various agencies, hospitals, and individuals involved.

Emergency Medical System Response

At approximately 7:30 AM on April 16, 2007, the Virginia Tech Rescue Squad received a 9-1-1 call about a person who had allegedly fallen out of bed in 1 of the campus dormitories. Upon arrival at the West Ambler Johnson Hall dormitory on the Virginia Tech campus, 2 gunshot victims were discovered. Virginia Tech Rescue requested and received mutual aid assistance from the Blacksburg Volunteer Rescue Squad. Both patients were transported to MRH, 3 mi from the dormitory. One of these 2 initial victims was pronounced dead on arrival (DOA) at MRH, and the second victim was transferred by ground ambulance to CMCR, the regional level 1 trauma center, having sustained a gunshot wound to the head. This patient died shortly after arrival at CMCR.

At 9:42 AM, a 9-1-1 call was received by Virginia Tech dispatch, reporting multiple shots fired at Norris Hall, a classroom building located on campus. At the same time emergency medical system (EMS) dispatch was receiving multiple telephone calls reporting the same event. Incident command was established on campus at 9:45 AM. The first mutual aid vehicle arrived on campus at 9:50 AM and staged in the forward staging area as directed by EMS command. Additional EMS assistance was requested via mutual aid with 14 agencies responding. These resources reported to a secondary staging area <.25 mi from campus. The Blacksburg Volunteer Rescue Squad offic-

ers directed staging units into the Virginia Tech campus as requested from EMS command and also assumed responsibility for covering other Blacksburg calls not related to the Virginia Tech incident. Staffing levels were adjusted for all of the staged ambulances to ensure that each was staffed by advanced life support providers.

Initial law enforcement response included 2 tactical medics, 1 from Virginia Tech Rescue and 1 from Blacksburg Volunteer Rescue Squad. After the safety of Norris Hall was ensured, additional EMS providers from Virginia Tech Rescue and Blacksburg Volunteer Rescue Squad were allowed in the building to assist the tactical medics with triage, treatment, and evacuation of patients. Mobile “green” patients, as defined by START Triage,⁵ were treated at the scene to prevent overloading the hospitals. “Red” and “yellow” patients, those with the most critical injuries, were rapidly transported to hospitals. High winds with gusts up to 60 mph precluded air transport, necessitating ground transport.

Twenty-five of the 26 patients were triaged in the field; 64% (16/25) of the patients were either field triaged as red (6/25) or yellow (10/25). All of the patients were transported from the scene by 10:35 AM. Most of the injured were transported to MRH, a level 3 trauma center (Table 1), with a subsequent transfer of 3 patients to the level 1 trauma center some 45 mi away.

Regional Hospital Coordinating Center and Hospital Response

The regional hospital coordinator received information from the scene of the shooting at 10:13 AM and activated the Regional Hospital Coordinating Center (RHCC). Operating procedures for the RHCC for incident command system were set in motion at that time. At 10:17 AM the RHCC notified the Virginia Hospital and Healthcare Association and the Virginia Department of Health office in Richmond of the situation in Blacksburg. Other hospital planning regions activated their RHCCs and logged onto Web EOC, the Web-based virtual emergency operations center and bed-monitoring system used throughout the state, to track hospital

TABLE 1

| Trauma Outcome | | | | |
|-------------------------------------|-------|-------|------|-------------|
| Hospital | MRH | CNRV | LGH | CMCR |
| Distance from scene to hospital, mi | 3 | 18 | 36.1 | 45.1 |
| Trauma designation | 3 | 3 | None | 1 |
| Triage (patients referred) | | | | |
| Red | 3 (2) | 3 (1) | 0 | 3 (1 death) |
| Yellow | 5 | 1 | 4 | 0 |
| Green | 9 | 0 | 1 | 0 |
| ISS ≥ 9 | 7 | 3 | 2 | 3 |
| ISS ≥ 15 | 4 | 1 | 0 | 3 |
| Surgery first 24 h | 7 | 2 | 1 | 1 |

Overall overtriage = (Total no. of patients triaged red or yellow – no. of patients with ISS ≥ 15)/Total number of red and yellow patients. Overall overtriage 11/16 = 69%. Overall health system mortality 1/26 = 3.8%. Critical mortality rate (ISS ≥ 15) 1/5 = 20%.

resource availability and bed accessibility. The RHCC remained engaged with regional coordination efforts throughout the remainder of the event, standing down at 6:30 PM.

The regional hospitals closest to the campus in the New River Valley area, CNRV, Pulaski Community Hospital, and MRH, activated their EOCs after notification of possible mass casualties with the second shooting incident. CMCR, the level 1 trauma center in the region, and LGH in Salem also activated their EOCs. Montgomery Regional Hospital canceled all of its elective surgeries and instituted designated disaster protocols, and CNRV postponed all of its elective surgeries until the event had been cleared. Lewis Gale Medical Center canceled some elective surgeries and notified hospital staff to be available to assist MRH if necessary. Pulaski Community Hospital also made staff available to other regional hospitals. Carilion Medical Center in Roanoke postponed some elective surgery and assembled a number of trauma teams to be available to respond if needed.

The first of the injured from Norris Hall to present to a hospital, a "green" patient with a soft tissue injury, arrived by public transportation at MRH at 10:05 AM. All of the other patients (25/26) were triaged by EMS personnel on the scene and transported to hospitals by ground transport. On arrival at the hospital, all of the patients were met by a triage officer appointed by the hospital. The triage officer was either a surgeon or an emergency physician, who directed yellow and green patients to the waiting room. All of the red and yellow patients were evaluated immediately by a code team in an operating theater. Table 1 shows which patients were received by each of the regional hospitals, as well as the trauma center designation for each hospital.

In-hospital Casualty Load

Of the 26 injured people who were evaluated at the hospitals, 19 had penetrating injuries from gunshot wounds, 4 had blunt trauma from falls, 1 had burns, and 1 had asthma. Twelve patients had an ISS of ≥ 9 , and 5 had an ISS score of ≥ 15 . Ten of the 26 patients (38%) required urgent intervention and surgery in the first 24 hours. Slightly more than 50% (14/26) of the victims were male, and the average age of the patients presenting was 25 years old (Table 2 and Fig 1).

One patient, 1 of the first 2 shooting victims from the dormitory, died after arrival at a hospital. The overall regional health system mortality rate of the victims received was 3.8% (1/26). The critical mortality rate, excluding 1 victim who was DOA, was 20% (1/5). Overtriage, as defined as the assignment of a higher priority for immediate treatment than warranted given the resources available,^{3,4} was 69% (11/16). Only 1 patient was found to be "undertriaged"; the patient was initially given a yellow tag in the field, but upon reevaluation in the emergency department was found to have a bullet entry wound to the flank, which led to retroperitoneal bleeding and hematoma.

TABLE 2

| In-hospital Casualty Load | |
|---------------------------|-------------|
| Procedures | No. in 24 h |
| Arterial repair | 1 |
| Chest tube | 1 |
| Endotracheal intubation | 5 |
| Exploratory laparotomy | 3 |
| Incision and drainage | 4 |

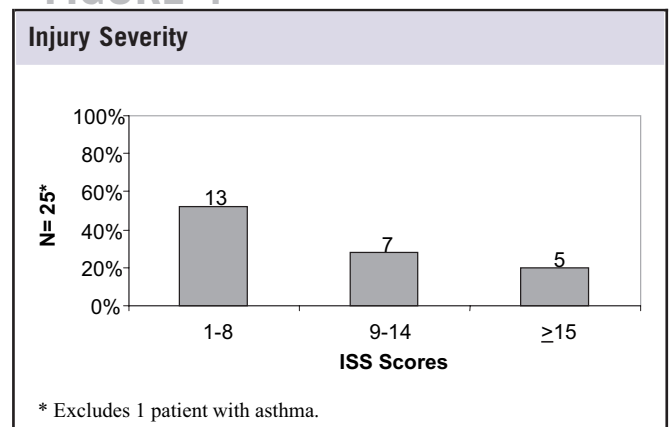
DISCUSSION

Since the events of September 11, 2001, much national attention has been focused on mass casualty preparedness and response. In particular because of the attack on the Pentagon that day, the Commonwealth of Virginia has heeded this concern and, through the Health Resources and Services Administration National Bioterrorism Hospital Preparedness Program, has been able to fund and establish a regional health system model for responding to such an event.

The outcomes of the Virginia Tech mass casualty incident, as evidenced by the low overall regional health system mortality of victims received at 3.8% (1/26) and low critical mortality rate (excluding 1 victim who was DOA) of 20%, coupled with a need to treat a significant amount of moderately injured victims 46% (12/26 with ISS ≥ 9) gives credence to the successful response. The victim characteristics from this response support historical precedence that gunshot victims as compared to bomb blast victims have a higher propensity for moderate injury (ISS ≥ 9) and have a slightly higher inpatient mortality.⁶ Furthermore, data from Israel have demonstrated the critical need for adequate immediate resuscitation because a high percentage of mortality in gunshot victims occur during day 1.⁶

Although the mechanism is different from a bombing, this was a regional health system response to a mass casualty incident. Therefore, for mass casualty health system comparison, critical mortality rates following other traumatic mass

FIGURE 1



casualty incidents are typically around 30%, with the exception of the July 2005 London bombings, at 15%.^{3,7-9} Elevated critical mortality rates are also associated with overtriage^{3,4}; however, the overtriage rate for the Virginia Tech response was 69%, which is slightly lower than in other mass casualties.^{3,7,8,10} It is also plausible that overtriage was also reduced because patients were equitably transferred and distributed throughout the regional health system.

It should be emphasized that this was a rural health system response with significantly impeded access to a level 1 trauma center. This possibility was recognized shortly after 9/11 by the Near Southwest Virginia Preparedness Alliance, as well as other rural regions of the Commonwealth, where planning for medical surge has included increasing the capability of all hospitals to respond to mass trauma events, along with the ability to handle burn patients. This program, known as the Traumatic Injury Cooperative Program, is based on developing mentoring relationships between designated and nondesignated trauma centers, and is in the process of final development for possible statewide implementation. Therefore, when patients could not be air evacuated due to 60-mph wind gusts, the local regional health system was capable of providing stabilization and necessary surge capacity.

The successful health system response occurred as a consequence of regional collaborative planning, training, and exercising, which resulted not only in increased expertise and improved communications but also in forging essential relationships and a sense of trust among all of the responders. All of the hospitals have been engaged in emergency planning efforts through the involvement of the Virginia Hospital and Healthcare Association, the Virginia Department of Health, and the Health Resources and Services Administration National Bioterrorism Hospital Preparedness Program. Regional hospital emergency planning efforts have superseded business competition among hospital and health systems, resulting in a coordinated hospital emergency response statewide. In addition, the close working relationship between state and local public health and Virginia's health care system has resulted not only in an overall improved response to mass casualty events but also in improved communications, allowing for earlier identification and response to infectious disease outbreaks and other public health emergencies.

Media and the Press

The 2 New River Valley hospitals receiving patients, MRH and CNRV, as well as CMCR, received extensive attention from both local and national media. Although most media personnel assigned to cover the event respected the ground rules for access to the hospital and to the patients and their families, other media personnel went to extraordinary and at times creative lengths to gain access. Because of the influx of media personalities, and to protect hospital personnel and

the victims and their families, both New River Valley facilities went to lockdown status with access by hospital ID badge only.

After-action Report

The after-action report from this event did identify areas in need of improvement, including the need for a unified patient tracking system for both EMS and hospitals, as well as the need for improved communications between the university and the health care system for any college or university event. The Near Southwest Virginia Preparedness Alliance will address these issues and share their experiences, lessons learned, and modifications to their emergency plans with hospitals, EMS agencies, and public health statewide.

One key lesson from this event is that mass casualty situations can occur anywhere in the country, including rural areas where access to a trauma center is limited or unavailable. The challenges faced by the regional health system in providing care to the victims of the April 16 shooting event at Virginia Tech are similar to those discussed in the Centers for Disease Control and Prevention's *In a Moment's Notice: Surge Capacity in Terrorist Bombings*.¹¹ Although the injuries may not have been as complicated to manage or the numbers of injured as large as expected with an explosive event, the issues are similar. The CDC's document emphasized the importance of organization and leadership, possible alterations in standards of care, education, communications, transportation, infrastructure and capacity, potential bottlenecks, triage and legal issues, all of which were issues in this shooting incident. The lessons learned from the Virginia Tech shooting incident will assist EMS, health care, and public health systems in Virginia to improve planning for medical surge situations in general and mass casualty incidents in particular.

About the Authors

Lisa Kaplowitz is Deputy Commissioner for Emergency Preparedness and Response at the Virginia Department of Health, Morris Reece is Executive Director of the Near Southwest Preparedness Alliance, Jody Henry Hershey is District Director of the New River Health District, Virginia; Carol M. Gilbert is Assistant Director of Trauma, Carilion Medical Center, and Italo Subbarao is Director of the Public Health Readiness Office, American Medical Association.

Correspondence and reprint requests to Dr Lisa Kaplowitz, Deputy Commissioner for Emergency Preparedness and Response, Virginia Department of Health, 109 Governor St, Richmond, VA 23219 (e-mail: Lisa.Kaplowitz@vdh.virginia.gov).

Received for publication June 19, 2007; accepted June 28, 2007.

ISSN: 1935-7893 © 2007 by the American Medical Association and Lippincott Williams & Wilkins.

DOI: 10.1097/DMP.0b013e318149f5a2

REFERENCES

1. Holley J. Students recount shootings. *Washington Post*. April 16, 2007. <http://www.washingtonpost.com/wp-dyn/content/article/2007/04/16/AR2007041600826.html>. Accessed July 20, 2007.

2. Baker SP, O'Neill, B Haddon W, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. *J Trauma*. 1974;14: 187–196.
3. Frykberg ER, Tepas JJ. Terrorist bombings. Lessons learned from Belfast to Beirut. *Ann Surg*. 1998: 569–576.
4. Frykberg ER. Medical management of disasters of mass casualties from terrorist bombings: how can we cope? *J Trauma*. 2002;53: 201–202.
5. <http://www.citmt.org/start/overview.htm>. Accessed June 6, 2007.
6. Peleg K, Aharonson-Daniel L, Stein M, et al. Gunshot and explosion injuries: characteristics, outcomes, and implications for care of terror-related injuries in Israel. *Ann Surg*. 2004;239: 311–317.
7. Biancolini CA, DelBosco CG, Jorge MA. Argentine Jewish community institution bomb explosion. *J Trauma*. 1999;47: 728–732.
8. Cushman JG, Pachter HL, Beaton HL. Two New York City hospitals' surgical response to the September 11, 2001, terrorist attack in New York City. *J Trauma*. 2003;54: 147–155.
9. Aylwin CJ, König TC, Brennan NW, et al. Reduction in critical mortality in urban casualty incidents: analysis of triage, surge, and resource use after the London bombings on July 7, 2005. *Lancet*. 2006; 368: 2219–2225.
10. Peral-Gutierrez de Ceballos J, Turégano-Fuentes F, Pérez-Díaz D, et al. Casualties treated at the closest hospital in the Madrid, March 11, terrorist bombings. *Crit Care*. 2005;9: 104–111.
11. Centers for Disease Control and Prevention. *In a Moment's Notice: Surge Capacity in Terrorist Bombings*. CDC Web site. <http://www.bt.cdc.gov/masscasualties/surgecapacity.asp>. Accessed July 20, 2007.