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Managing Bioterrorism Mass Casualties in an Emergency Department: Lessons Learned From a Rural Community Hospital Disaster Drill

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Bioterrorism represents a threat for which most emergency departments (EDs) are ill prepared. In order to develop an evidence-based plan for ED and hospital management of contaminated patients, a review was conducted of the most effective strategies developed during the severe acute respiratory syndrome (SARS) epidemic, as well as Centers for Disease Control and Prevention and military guidelines on biowarfare. Six basic steps were identified: 1) lock down the hospital and control access to the ED; 2) protect emergency care personnel with appropriate personal protective equipment; 3) decontaminate and triage patients; 4) isolate patients; 5) treat patients with appropriate medications or measures, including decontamination of wounds; and 6) use restrictive admission and transfer guidelines. By emphasizing these six basic concepts, a rural ED passed an annual state-run bioterrorism mass-casualty drill. The drill provided health care personnel with the knowledge and skills necessary to prepare for future bioterrorism casualties. These same concepts could also be used to manage highly virulent viral or bacterial outbreaks.

The threat of bioterrorism has moved disaster medical planning to the forefront. After the September 11th terrorist attack on the World Trade Center, the US government formed the Department of Homeland Security. In an effort to assess the extent of hospital bioterrorism preparedness, the US General Accountability Office (GAO) surveyed 2041 hospitals.[1] The results disclosed an incomplete level of preparedness. While the majority of hospitals had provided bioterrorism classes to their employees; less than half had conducted drills simulating a bioterrorism incident. Hospitals reported that they would not have the equipment, specifically ventilators and isolation rooms, to manage these types of mass casualties. No standard emergency department (ED) protocols existed for conducting a medical response to a bioterrorism incident.

Guidelines published by the Centers for Disease Control and Prevention (CDC) and the National Institutes of Health (NIH) were perceived as impractical and cost-prohibitive for many community hospitals.[2] In order to improve our facility response, a 6- plan was developed to guide the medical management of bioterrorism casualties in the ED setting. These steps were then used during a state-mandated bioterrorism drill. These same steps could also be used to manage outbreaks of other highly virulent agents.

Materials and methods

The CDC instructions for hospital management of biowarfare disasters provide no specific guidelines for the ED.[2] Following a review of the most effective strategies used in the SARS epidemic, as well as CDC and military guidelines on biowarfare,[3] 6 basic areas were identified for effective ED management of individuals exposed to or contaminated with a biological agent. These included the following: 1) prevent hospital contamination by locking down the hospital and controlling access to the ED; 2) protect emergency care personnel through use of the appropriate level of personal protective equipment; 3) decontaminate patients to prevent ED contamination; 4) isolate patients; 5) treat patients with appropriate medications or measures, including decontamination of wounds; and 6) adhere to restrictive admission and transfer guidelines. These steps were used during a state mandated bioterrorism mass-casualty drill.

The severe acute respiratory syndrome (SARS) outbreak represented a good model for management of

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a biowarfare agent for several reasons. SARS is spread by airborne viral particles, is difficult to detect and identify, and is highly contagious. It also has the potential to cause widespread fear and panic. These are all characteristics of an effective biowarfare agent.

One of the foremost hospital priorities continues to be preventing a hospital outbreak and contain the epidemic. In Taiwan, 100 hospitals were surveyed regarding their response to SARS.[4] These surveys revealed many attempts at patient management, the most successful of which resulted in good outcomes as measured by low rates of hospital and staff infection. The largest contributor to staff infection rates was a delay in acknowledging the infectious disease emergency.[4] In Taiwan, several hospitals delayed calling the SARS epidemic a disaster. This was because of concerns that implementing strict infection-control protocols would decrease the other hospital services and incite panic. The EDs that implemented disaster infection control procedures early in the outbreak reported that fewer than 9% of their employees had a fever and had to stay home. This was compared to 47% of employees of hospitals who delayed in calling the epidemic.[4]

In both Taiwan and Toronto, hospital administration restricted access by limiting the number of entranceways.[9] Several hospitals used existing lockdown procedures, such as those used for riots or fires, and involved announcing a disaster code over the PA system and coordination with security personnel.

Because the most important route of exposure to biological agents is through inhalation, respiratory precautions were necessary.[6] The CDC recommends that N95 masks be used as a minimum, with powered air purifier respirators being the standard if the contaminate is unknown.[7] Complete biohazard suits (personal protective equipment [PPE] level A) are expensive and should be used in the hot zone were the possibility of contamination is the greatest. During the SARS epidemic, the Toronto and Taiwan EDs used mostly level D working PPE: eye protection, gloves, gown, and N95 masks.[9]

Biowarfare victims need to be carefully managed from the point of the event through hospital admission. Prehospital protocols based on the CDC guidelines for contaminated or infectious individuals are taught to most emergency medical system first responders; thus, a discussion of the prehospital response is not addressed here.[1] Although many hospital plans are predicated on the notion that contaminated individuals will be decontaminated prior to transport, most studies show that patients will not be decontaminated on site and transported.[8] Therefore, patients must be grossly decontaminated before entering a medical facility; a decontamination tent or isolated shower may be used.

The SARS outbreak represented a good model for management of a biowarfare agent.

The decontamination process includes removing and securing contaminated clothing (in biohazard bags), gently scrubbing the skin to mechanically remove large dry particles, and showering or bathing with soap and copious amounts of water. In a nonideal setting, a warm water hose can be used for decontamination.[8]

Once free of visible contamination, patients are transferred to a clean area known as the cold zone, usually located inside the ED. A tape or rope line is used to physically and visibly demarcate the hot from the cold areas. Once decontaminated and located in the cold zone, patients are retriaged, have their wounds redressed, and have other devices reapplied.

Patient quarantine was addressed both by physically isolating patients and by having them wear surgical masks. Isolation rooms may quickly fill, requiring the use of other non-ED treatment areas in order to separate exposed individuals from other ED patients. Toronto hospitals used separate buildings for triage and patient care.[9] Surgical masks on patients can help limit aerosolized particles when N95 masks are not available.

Initial priorities are initiation of resuscitation and stabilization measures, followed by rapid disposition decisions. Definitive laboratory testing will be limited to specialized facilities. Therefore, a working diagnosis should be made based on clusters of symptoms (i.e., pulmonary complaints can be caused by tularemia, plague, or anthrax). Since our scenario presumed anthrax exposure, ciprofloxacin was used as the Food and Drug Administration—approved drug of choice for anthrax exposure and treatment. Doxycycline (200 mg intravenous (IV) load, followed by 100 mg IV every 12 hours) was used for pregnant patients, children, and individuals allergic to ciprofloxacin. Weight-based dosing of doxycycline was available for children less than 12 years of age.[3]

Anthrax prophylaxis involves the use of ciprofloxacin for 4 weeks until receiving 4 doses of the anthrax vaccine. The vaccine is handled by the CDC and should be started immediately. Oral doxycycline (100 mg twice a day) or amoxicillin (500 mg every 8 hours) were acceptable alternatives for pregnant females or appropriate weight-based dosing for children less than 12 years of age.[3] Treatment guidelines for other potential bioagents are available in numerous references.[2]

In Taiwan and Toronto, lack of beds led to restrictive admission and transfer behaviors. In Toronto, transfers were discouraged, as certain hospitals

became designated SARS centers. Conversely, Taiwanese tertiary medical centers received multiple transfers from outlying rural EDs. These rural EDs subsequently limited their contamination rate by transferring potentially infectious patients once their own bed capacity was reached. Lack of isolation rooms became the key reason for transferring patients out and restricting the admissions.[4]

Drill Scenario

The setting for our drill was an ED in a rural 150-bed hospital in western Pennsylvania in the month of October. The bioterrorism drill started when the ED received a radio report that multiple bomb casualties were being transported and would arrive in 15 minutes. The casualties were student volunteers from a local college who had simulated wound and burn injuries. The scenario was that a bomb had exploded in a crowd, dispersing a white substance. The hazardous material team (HAZMAT), fire, police, and ambulance personnel were deployed on scene.

After receiving notification of the drill, a hospital command center was established in a conference room near the ED. Personnel were assigned roles such as team leader, communications leader, medical director, logistics leader, etc. A public affairs spokesman was assigned to interface with the media and community.

Lockdown/Restricted Access

The hospital implemented an existing fire/riot lockdown protocol, which involved dispatching security officers to the hospital entrances and placing signs at the entrances directing victims to the ED. A second entrance was made available for victims into the ED.

Protection of Personnel

The hospital only had 1 level A PPE suit with a powered respirator. This was given to the emergency medical technician (EMT) in the hot zone (area of contaminations). Other emergency personnel wore level D (working PPE): N95 masks, disposable gloves, gowns, and goggles. Visitors were restricted to 1 per patient and were required to wear gowns, surgical masks, and gloves.

Decontamination and Triage

The 7 patients who arrived by ambulance had been decontaminated at the scene. Surgical masks were placed on these victims and they were then triaged according to injury status. Three contaminated ambulatory patients walked to the front hospital entrance and were then directed to the ED via an outside shower with a separate entrance. This area had 1 EMT in level A PPE. The shower had an entrance and an exit door with a litter, stool, and sponges. The victims were told that, in a real emergency, they would be instructed to remove their clothes, shower with soap, and then put on gowns.

Patients were then moved from the contaminated area (hot zone), through outside doors and a roped area, into a clean area (cold zone). The clean area was the hallway outside the ED behind another set of doors where patients would wait on chairs or cots to be retriaged.

Patient Quarantine

The ED health care workers who assumed care of contagious patients also wore level D (working PPE). Once the patients were ready to be examined, they were moved into 1 of 3 rooms that were physically isolated from other ED beds. When isolation rooms were filled, patients were moved into a separate area of the ED to quarantine them from other patients.

Patient Treatment

Treatment was based on injury types. Two patients reported airway problems and were designated as being intubated. Contaminated wounds were treated by gently brushing dry powder off and then washing the involved areas with soap and water. Five patients had simulated first- and second-degree burns, as well as lacerations and abrasions. These "required" multiple liters of intravenous fluid, 10 mg of morphine each for pain, and burn dressings.

After the obvious injuries were treated, the white powder exposure was addressed. In real life, anthrax takes days to become symptomatic. However, for purposes of the drill, a working diagnosis of presumptive anthrax exposure was made; differential diagnoses included plague and tularemia.

Ciprofloxacin (400 mg IV every 12 hours) was "administered" to those acutely ill with respiratory symptoms. Exposed health care workers were told to take ciprofloxacin prophylaxis and follow up with occupational health for vaccines. Disposition was then made regarding patient admission or discharge.

Isolation rooms may quickly fill, requiring the use of other non-ED treatment areas in order to separate exposed individuals from other ED patients.

Restrictive Admission and Transfer Guidelines

The medical command decided to limit admissions to the 3 available inpatient isolation rooms. Based on this census, 5 symptomatic patients were transferred out and 2 patients were designated as admitted. Three patients with only lacerations were discharged with

prophylactic ciprofloxacin (500 mg twice a day) until follow up with occupational health for vaccines.

Discussion

The state inspector ended the exercise, informing the ED and hospital personnel that they had passed the annual terrorism mass casualty drill. Two other hospitals participating in the same drill failed because contaminated ambulatory victims were not directed to the ED and walked through the hospital, spreading the white powder and contaminating the facility. No further information was available about these hospitals' inspections.

Several areas of concern were noted during the drill. The first was an overall lack of health care workers trained in proper response to a bioterrorism event. While all employees had received general bioagent education, neither pre-hospital nor ED personnel had participated in a bioagent drill. One EMT had HAZMAT training in decontamination procedures from a previous job.

A lack of appropriate PPE was identified. The only working level A respirator suit was difficult to work in and required training to use as well.

The entire decontamination area was unrealistic. The shower room used for decontamination would not accommodate both a litter and the minimum of 2 people needed to properly decontaminate a patient. Actual mock decontamination of the victims was not done and would have contributed to the educational experience. In general, much training is needed regarding the decontamination and triage of victims.

An overall lack of health care workers trained in proper response to a bioterrorism event was identified.

Problems with lockdown and visitor restriction were identified. The number of hospital security officers was insufficient to enforce limiting hospital access. Signs and patient/visitor compliance were relied upon to prevent hospital contamination.

Patient treatment issues included treatment and prophylaxis of exposed hospital personnel. The facility lacked an occupational health protocol for management of employee anthrax exposure.

Admission guidelines required knowledge of the current bed status in our own and surrounding hospitals. Transfers were difficult and it was quickly realized that accepting hospitals would not want contaminated patients in a real quarantine situation. This was identified as an area for collaboration with the regional emergency medical services and hospital association.

Conclusion

The development of a realistic bioterrorism mass-casualty management protocol involves evidence-based research. Lessons learned from the SARS epidemic provide insight in the actual response to a contagious pathogen. Realistic drills and training provide ED and hospital personnel with the knowledge and skills required to respond to such an event.

The rural hospital passed the state run bioterrorism drill while using the 6 concepts outlined in this article. Although the anthrax scenario was not realistic in the time frame from exposure to illness,[5] the concepts were important.

The six concepts identify critical areas in the effective management of biocontaminated victims and could also be used to manage highly virulent viral or bacterial outbreaks. By incorporating these concepts into an ED bioterrorism response, hospitals can be better prepared for an actual bioterrorism attack or contagious infection incident.

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