The Chemical Disaster Response System in Japan

Tetsu Okumura, MD, PhD;[1] Norifumi Ninomiya, MD, PhD;[2] Muneo Ohta, MD, PhD[3]

1. Assistant Professor, Emergency Department, Juntendo University Hospital, Tokyo, Japan; Member, Serious Chemical Hazard Task Force, Government of Japan
2. Associate Professor, Department of Emergency and Critical Care Medicine, Tama-Nagayama Hospital, Nippon Medical School, Tokyo, Japan
3. Chairperson, Japanese Association for Disaster Medicine, President-elect, World Association for Disaster and Emergency Medicine

Correspondence:
Tetsu Okumura, MD, PhD
Emergency Department
Junlendo University Hospital
Hongo 3-1-3, Bunkyo-City
Tokyo 113-8431, Japan
E-mail: xj2t-okmr@asahi-net.or.jp

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Abbreviations
e-list = electronic lists
EMS = Emergency Medical Services
EMT = Emergency Medical Technician
JPIC = Japanese Poison Information Center
NBC = nuclear, biological, chemical
PPE = personal protective equipment

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Abstract

During the last decade, Japan has experienced the largest burden of chemical terrorism-related events in the world, including the: (1) 1994 Matsumoto sarin attack; (2) 1995 Tokyo subway sarin attack; (3) 1998 Wakayama arsenic incident; (4) 1998 Niigata sodium-azide incident; and (5) 1998 Nagano cyanide incident. Two other intentional cyanide releases in Tokyo subway and railway station restrooms were thwarted in 1995. These events spurred Japan to improve the following components of its chemical disaster-response system: (1) scene demarcation; (2) emergency medical care; (3) mass decontamination; (4) personal protective equipment; (5) chemical detection; (6) information-sharing and coordination; and (7) education and training. Further advances occurred as result of potential chemical terrorist threats to the 2000 Kyushu-Okinawa G8 Summit, which Japan hosted. Today, Japan has an integrated system of chemical disaster response that involves local fire and police services, local emergency medical services (EMS), local hospitals, Japanese Self-Defense Forces, and the Japanese Poison Information Center.

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Introduction

The history of events related to chemical warfare agents in Japan dates back to World War II. From 1944 to 1946, more than 5,000 Japanese workers involved in the production and subsequent decommissioning of chemical weapons were injured by chemical warfare agents.[1] Following the dismantling of the Japanese chemical weapons program, Japan enjoyed a 50-year respite from major chemical emergencies until the emergence of chemical terrorism in the mid-1990s. This article reviews the recent burden of chemical terrorism in Japan and the chemical emergency response system that evolved as a result.

Recent Chemical Terrorism-Related Events

During the 1990s, Japan experienced the largest burden of chemical terrorism-related events in the world. The first chemical attack occurred on 27 June 1994, when the Aum Shinrikyo cult members released sarin from a truck into a crowded residential area in Matsumoto, killing seven and injuring 586 persons.[2] Less than a year later, on 20 March 1995, Aum Shinrikyo terrorists released sarin vapor in five subway trains of the Tokyo subway system, killing 12 and injuring >5,500 persons.[3–6] On two occasions later that year, Aum Shinrikyo terrorists placed cyanide-gas-producing devices in a total of five public restrooms in the Tokyo subway and railway stations. All of these devices were discovered before cyanide was released.

During 1998, >30 intentional chemical releases were reported in

Japan. On 25 July 1998, arsenic was deliberately mixed into a curry and rice meal that was served at a summer festival in the community of Wakayama, killing four and injuring 58 festival-goers.[7] A few weeks later, on 10 August 1998, someone deliberately added sodium azide to the contents of a teapot in Niigata, poisoning nine persons. This event was publicized widely in Japan, leading to five more copy-cat incidents involving sodium azide. On 31 August 1998, someone contaminated a can of oolong tea produced in Nagano with cyanide via a pinhole in its base, killing one person.

Chemical Emergency Response System in Japan

The 1995 Tokyo subway sarin attack was a watershed event for the development of the chemical emergency response system in Japan. Following this attack and the ensuing flood of smaller chemical releases in 1998, Japan began to improve the following components of its chemical disaster response system: (1) scene demarcation; (2) emergency medical care; (3) mass decontamination; (4) personal protective equipment (PPE); (5) chemical detection; (6) information-sharing and coordination; and (7) education and training.

The 2000 Kyushu-Okinawa G8 Summit provided further impetus for the Japanese government to refine its emergency management of chemical events. As the host nation for this high-profile meeting, Japan recognized the potential for a terrorist attack involving the use of nuclear, biological, or chemical (NBC) agents, and sought to further improve many of the system components described below.

Scene Demarcation

Prior to the 1995 Tokyo subway sarin attack, emergency response at the scene of a chemical release was divided into two areas, a "dangerous zone" (contaminated area) and a "safe zone" (uncontaminated area). Following the attack, authorities recognized the need to delineate a physical area for the on-scene decontamination of victims and responders. Accordingly, emergency response at the scene of a chemical incident is now demarcated into a hot zone (contaminated area), a warm zone (area where decontamination occurs), and a cold zone (uncontaminated area).

Emergency Medical Care

Before the 1995 Tokyo subway sarin attack, on-scene physicians were not equipped with nerve agent antidote auto-injectors. Since the attack, physicians of the Japanese Self-Defense Forces have been supplied with antidote auto-injectors and the education and training required for their use.

Despite this advance, a number of critical areas in the emergency care of victims of chemical terrorism still must be addressed. First, under Japanese law, only physicians are allowed to perform endotracheal intubation and administer medications to the victims of a chemical attack at the site of an incident. Despite the lessons learned from the Tokyo subway sarin attack, Japanese emergency medical technicians (EMTs) still are prohibited from performing these life-saving interventions.[4] Second, physicians in Japan primarily are hospital-based, and do not routinely participate in out-of-hospital emergency responses. In addition, the Japanese Disaster Medical Assistance Team concept is quite young and the study of its effectiveness has just begun. Third, the Japanese Self-Defense Forces, including its physicians, are restricted legally from responding to a terrorist event involving the use of chemicals unless the local Governor gives his or her permission due to the so-called "civilian-control dogma", thus creating yet another barrier to the performance of life-saving emergency care at the scene of a terrorist attack involving the use of chemicals.

Mass Decontamination Systems

Prior to the Tokyo subway sarin attacks, none of the fire services had systems to provide mass decontamination. They only had sufficient systems for decontamination of first responders. Following the attack, authorities recognized that hospitals also must be able to decontaminate chemically contaminated victims who come to hospitals without using the emergency medical services (EMS) system.[8] As a result, the Japanese Ministry of Welfare distributed mass decontamination equipment and supplies to 130 hospitals located throughout Japan. In addition, authorities are planning to widen the distribution of mobile decontamination systems to include the fire services. These mobile decontamination systems are comprised of inflatable tents with two decontamination lines (one for ambulatory and another for non-ambulatory patients), a warm water supply, wastewater collection, lighting, and air-conditioning.

Personal Protective Equipment (PPE)

In the 1940s, Japanese workers injured while handling chemical warfare agents were largely unprotected by PPE. Prior to the 1995 Tokyo subway sarin attack, on-scene emergency response units and hospitals still were not equipped with sufficient types and quantities of PPE required for the management for chemical events. Following the attack, authorities recognized the need for PPE at all levels of emergency response. Today, local fire and police services, and the Japanese Self-Defense Forces are equipped with sufficient types and quantities of PPE (including Level-A). In addition, the Japanese Ministry of Welfare distributed PPE to hospitals throughout Japan. A major limitation is that only four sets of PPE have been provided to each hospital.

Chemical Detection

In the early 1990s, Japan had only a limited capacity to detect chemical agents involved in terrorism-related events. During the Tokyo subway sarin attack, the Tokyo Metropolitan Fire Defense Agency had personnel and analysis equipment, but was unable to identify sarin, since it was not included in its library of possible substances. Meanwhile, the Tokyo Metropolitan Police Agency was able to identify the sarin within three hours of the attack, but only because it had the benefit of information collected in the 1994 Matsumoto sarin incident. In the 1998 Wakayama arsenic incident, it took eight days for the victims to be diagnosed as having arsenic poisoning (they were first diagnosed with food poisoning, and later, with

Feature
▪ Dispatch of firefighter first responders wearing level-A PPE
▪ Zone demarcation into hot, warm, and cold zones by firefighter first responders
▪ Establishment of on-scene decontamination facilities in the warm zone
▪ Establishment of an on-scene command center in the cold zone
▪ Unified command and control at the on-scene command center, involving police services, fire services, Japanese Self-Defense Forces, and EMS
▪ Information-sharing at the on-scene command center
▪ Identification of the responsible chemical agent (e.g., sarin)
▪ Identification and rescue of victims in hot zone by firefighters wearing level-A PPE
▪ Evacuation of victims to from hot zone to warm zone, with simple respiratory support
▪ Triage of victims at primary triage post in warm zone
▪ Direction of ambulatory victims to one decontamination area and non-ambulatory victims to another decontamination area within the warm zone
▪ Provision of basic life support to non-ambulatory victims at primary triage post
▪ Decontamination of the victims within the warm zone
▪ Protection of privacy, management of personal belongings, and prevention of hypothermia during decontamination
▪ Provision of emergency medical care during decontamination, including antidotal therapy upon identification of responsible chemical agent
▪ Transport of decontaminated victims into the cold zone
▪ Secondary triage of victims into "red", "yellow", or "green" categories according to the severity of their injuries at secondary triage post in cold zone
▪ Prioritized EMS transport of decontaminated victims from cold zone to hospitals according to triage classification
▪ Prioritized provision of emergency medical care to victims in cold zone awaiting transport to hospitals according to triage classification
▪ Hospital decontamination of victims who bypass EMS and go directly to hospitals (outside hospital)
▪ Environmental decontamination of the hot zone by Japanese Self-Defense Force personnel wearing level-A PPE

Table 1—Features of chemical disaster response in Japan (EMS = emergency medical services; PPE = personal protective equipment)

cyanide poisoning). These events underscored the need for Japan to create the laboratory capacity for the rapid detection of chemical agents used in terrorism-related events. In 2000, the Japanese Government distributed chemical analysis equipment to 73 emergency centers throughout Japan, including gas chromatography/mass spectrometry, high performance liquid chromatography, and induction combination plasma mass spectrometry technology. In addition, eight major Japanese cities have established NBC task forces and have positioned the necessary chemical analysis equipment in their local police departments. The Japanese Self-Defense Force also has established the laboratory capacity for rapid detection of chemical agents.

Information Sharing and Coordination

Although Japan had two poison information centers before the Tokyo subway sarin attack, no systems for information sharing were in place in case of a chemical disaster. After the attack, the Japanese Government compiled a list of key personnel with expertise in the management of chemical incidents, began to convene regular meetings, and set-up an electronic list (e-list) of clinical toxicologists. Non-governmental e-lists for clinical toxicologists also were established. These e-lists now comprise standard routes for the exchange of information about chemical poisoning in Japan. At the same time, the Japanese government created a model for the coordination of responses to events involving the use of chemicals; the emergency responses are coordinated at the local level by an on-scene command center and at the national level by the Japanese Poison Information Center (JPIC). According to this model, the community EMS dispatch station collects information regarding the victims' condition from the hospitals via fax and forwards this information to the JPIC using fax transmission. Using this information, the JPIC then determines a possible cause and faxes its impression back to the community EMS dispatch center, which, in turn, relays this information to the hospitals (also using fax). In the 1998 Wakayama arsenic incident, the emergency medical technicians (EMTs) distributed the victims to hospitals throughout the city. As a result, news that the first case had died in a hospital did not reach the other hospitals (where physicians believed that the cause of this incident was non-lethal food poisoning) until the next morning after four of the victims had died.

Education and Training

Prior to the Tokyo subway sarin attack, no education and training programs were in place for the emergency management of chemical disasters in Japan. Following the attack, the Japanese Poison Information Center established seminars for chemical disaster management for emergency physicians and laboratory analysis for laboratorians. In March 2001, the Japanese Poison Information Center conducted three-day seminars for emergency physicians in Tokyo and Osaka that included lectures and tabletop exercises (repeated every year since). The Japanese Society for Clinical Toxicology also holds education and training programs for laboratorians. In addition, the Japanese Association for Active Medicine also has provided physicians with training in decontamination and the proper use of PPE, and the Japanese Association for Disaster Medicine produced an educational video that demonstrates the integrated chemical disaster response to the release of an unknown gaseous substance.[9] According to the scenario shown in the video, numerous victims have collapsed in a park, and telephone calls for emergency assistance reach the local fire department first. At the beginning, it is unclear whether the scenario involves as intentional chemical release or a deliberate terrorist attack. Responding organizations include local fire services, police services, EMS, and the Japanese Self-Defense Forces. The key features of the chemical disaster response depicted in this video have been conducted (Table 1). An NBC terrorism emergency management seminar. Although these activities are listed in a given order, many occur simultaneously as the emergency responses unfolded. The Japanese Association for Disaster Medicine intends to distribute this video widely in order to assist with the education and training of emergency responders throughout the country.

Conclusion

Over the past decade, Japan has experienced the largest burden of chemical terrorism-related events in the world. These events have spurred Japan to develop a chemical disaster response system that involves local fire and police services, local EMS, local hospitals, Japanese Self-Defense Forces, an on-scene unified command center, various laboratories attached to these entities, and the Japanese Poison Information Center. While many components of a mature chemical disaster response system have been established since the 1995 Tokyo subway sarin attacks, a number of deficiencies still must be addressed.

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