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The Tokyo Subway Sarin Incident: Emergency Medical Response by St. Luke's International Hospital

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Medical responses to disasters vary greatly depending on the nature and scope of the incident. In a large-scale natural disaster, such as the Great Hanshin-Awaji Earthquake, medical facilities, communication networks, transportation, and lifelines [infrastructure such as electricity, gas, and water] are damaged, hindering effective medical response. The Tokyo Subway Sarin Incident was an unnatural disaster with a more limited scope. In other words, the sarin incident differs from a large-scale natural disaster in that medical facilities, communication networks, transportation, and lifelines remained undamaged. In this paper, we will present what St. Luke's International Hospital (SLIH) did after the Tokyo Subway Sarin Incident and examine some problems that need to be addressed.

Normal Emergency Response at SLIH

SLIH is a general hospital with 520 beds and approximately 2,000 outpatients on a typical day. In an emergency, doctors in the Emergency Department and nurses in the Emergency Medical Center (EMC) normally guide operations and request help from other departments if necessary. Each year we receive approximately 5,000 ambulances and treat over 20,000 emergency patients.

Overview of the Tokyo Subway Sarin Incident

On the morning of March 20, 1995, a liquid substance, later determined to be sarin, was dispersed in five cars on three Eidan subway lines (the Hibiya, Marunouchi, and Chiyoda lines). This resulted in 11 deaths and more than 6,000 injuries at 15 stations.

Emergency Response at SLIH during the Tokyo Subway Sarin Incident

Overview of Patients' Visits

A number of patients came to SLIH within a few hours of the incident. We treated 640 patients on the day of the incident and 1,410 patients in total. **(Figure 1)**

Progress of Emergency Response Immediately Following the Incident

March 20, 1995 (Monday)

- **8:16am:** EMC received a direct phone call from the Tokyo Fire Department (TFD) requesting accommodations for the injured. TFD informed us that there appeared to be a fire from an explosion at Kayabacho Station on the Hibiya line. Anticipating patients suffering from burns, injuries, and carbon monoxide intoxication, we prepared two beds in the intensive care unit (ICU) and seven beds in the operating room. The doctors in the Emergency Department and nurses in the EMC prepared to treat the incoming patients.
- **Approximately 8:25am:** Three patients arrived at the EMC by walking from the incident site.
- **Approximately 8:40am:** A patient experiencing respiratory and optical disorders was dispatched by ambulance. Though the hazard was still unknown, the ambulance's emergency medical services (EMS) personnel told us to expect more patients because there were many injured people at the incident site.
- **Approximately 8:43am:** The first patient suffering cardiopulmonary arrest (CPA) arrived in a privately owned car that happened to pass by the incident site. We immediately started cardio-pulmonary resuscitation (CPR) on the patient. Soon afterwards, a second patient with CPA arrived, and we again initiated CPR. As more patients arrived either on their own or by ambulance, we began to provide emergency medical treatment in any available space in the EMC, including the building's corridors. By this time, we had determined that it would be impossible to respond to the patients with only emergency department staff. Therefore, we mobilized the entire medical staff through an "emergency call." Doctors and nurses from all the departments came to the EMC to assist.
- **8:55am:** Through intra-hospital radio communications, we asked that all available stretchers and drip-stands be brought to the EMC as soon as possible. As the number of patients grew, the EMC ran out of accommodation space. We immediately began transferring treated patients who could not walk to vacant wards in the main building. However, free rooms quickly became filled.
- **9:20am:** We began to accommodate the patients in the SLIH chapel.
- **9:30am:** The SLIH Director decided to cancel all routine procedures and introduce emergency response operations into the entire hospital. In order to accommodate victims in the operating rooms, scheduled surgeries were also temporarily suspended, except in cases where anesthesia had already been applied. In response to the TFD's request, eight doctors and two nurses were dispatched to the incident site. At the same time, we informed TFD that our facility was reaching maximum capacity and asked the department to transport patients to other hospitals if possible.
- **9:40am:** TFD informed us that the threat might be "acetonitrile," which causes cyanide poisoning. However, the patients' symptoms did not seem consistent with cyanide poisoning, and even the seriously injured did not have high methemoglobinemia readings. We suspected that the patients were suffering from some kind of organic phosphorous insecticide poisoning and started treating the seriously injured with "atropine sulfate," which is effective against organic phosphorous insecticide poisoning.

- **10:30am:** Doctors and nurses from the Japan Ground Self Defense Force Central Hospital arrived and provided voluntary assistance. They offered us knowledge and treatment procedures relating to sarin poisoning.
- **11:00am:** The SLIH Director and Associate Director held the first press conference. We decided to hold press conferences at scheduled times from then on in order to reduce confusion in the media.
- **Approximately 11:00am:** We received a call from Dr. Nobuo Yanagisawa, Director of Shinshu University Hospital, who had treated patients from the Matsumoto Sarin Incident. He told us that based upon the symptoms reported on television, the patients probably had sarin poisoning, and he sent us a fax with a detailed description of treatment for sarin poisoning.
- **Approximately 11:30am:** The Metropolitan Police Department (MPD) held a press conference and announced that the hazard was sarin. We learned this from television news reports and then shared the information through intra-hospital radio communications. We also asked all patients, including those with mild cases, to take off their jackets and put them into plastic bags.
- **12:00pm:** The executives and doctors in charge of the patients' treatment held the first staff meeting and discussed treatment procedures and the process of determining which patients could be discharged. Temporary telephones donated by Nippon Telegraph and Telephone Corporation (NTT) were set up outside the hospital.
- **Approximately 2:00pm:** We began the second round of physical examinations for those with minor injuries. Those with doctors' permission were discharged.
- **5:00pm:** We asked TFD whether we could transfer patients who needed hospitalization to other medical centers, but TFD replied that no ambulances would be available until 11:00pm. We explained the situation to the patients and their families and continued to treat them in the chapel. The Tokyo Metropolitan Government provided us with extra temporary beds.
- **Approximately 6:00pm:** Countries such as Germany, France, and Britain offered to dispatch emergency medical teams, but we asked them to provide only information regarding treatment because the situation had already started to settle down.
- **8:00pm:** During the day, we continuously worked to confirm the identification of patients. At 8:00pm, we completed identification of the last patients, including names, addresses, the severity of injuries, and accommodation details.
- **8:03pm:** We received a call asking for accommodations for a person suffering from CPA. Our emergency medical staff conducted CPR, but it was unsuccessful. We later determined that the patient's condition was unrelated to the sarin incident.
- **10:00pm:** The final version of the inpatients' list was completed and released to official institutions.

March 21, 1995 (National Holiday)

- **2:00am:** The doctors conducted rounds in the wards.

- **9:30am:** Due to the growing number of outpatients, including some returning outpatients, we decided to use the diagnosis room not only in the EMC, but also in the Internal Medical Department.
- **10:00am:** Through the doctors' rounds in the wards, we determined who could be discharged.
- **Approximately 1:00pm:** We held an all-staff meeting and decided how to treat the remaining patients.
- **5:00pm:** We restarted normal emergency operation at the EMC.

Overview of the Patients Treated on the Day of the Incident

The 640 patients we treated on the day of the incident included 395 males, 245 females, four pregnant women, and 13 children. Their ages ranged from 8 to 65, and the average age was 35. With regard to the classification of injuries, we had 528 with minor injuries, who were discharged on the day of the incident; 107 moderately injured, who could not walk by themselves; and five seriously injured needing intensive treatment. **(Figure 2)**

Method and Origin of Patient Transportation

Figure 3 explains how the patients were transported to SLIH. The figure shows that of the 498 patients surveyed, 174 patients came to the hospital on foot. Far more patients were transported by taxis and privately owned cars than by ambulances, TFD cars, and police cars.

Origin of Patients: Two-and-a-half times more patients were transported to SLIH from Kodemmacho Station, which was more than three kilometers away, than from the nearest station (Tsukiji).

Triage and Patient Accommodations

When SLIH was built in 1992, it was designed with large public spaces and wide corridors, as well as oxygen pipes built into the walls of the corridors and the chapel, so that it could accommodate 280 extra patients outside of the wards in the event of a catastrophe. However, on the day of the Tokyo Subway Sarin Incident, we temporarily had twice as many patients as we could accommodate, even when we utilized all available space.

The doctors triaged the patients at the EMC entrance and sent them to treatment areas according to the severity of injury. However, because patients began to arrive at entrances other than the EMC's, we placed doctors and nurses at those entrances for triage.

We treated patients who had minor injuries and could walk in the waiting rooms of every department. The moderately injured, those who could not walk but remained conscious, were accommodated in the vacant wards. After the wards were full, we started to accommodate these patients in the chapel. The seriously injured who needed respiratory monitoring first received CPR at the EMC and were then treated in the ICU.

After we released those who could be discharged, we continued treating 111 people as inpatients.

Secondary Contamination of Medical Staff

Sarin caused secondary contamination among our medical staff through patients' clothing. A survey of the medical staff revealed that 110 staff members (23.3%) out of the 472 that responded to the survey claimed some sort of contamination. The ratio of secondary

contamination according to occupation is as follows: 39.3% of the nursing assistants, 26.7% of the nurses, 25.5% of the volunteer staff, 21.8% of the doctors, 20.7% of the co-medicals, and 18.2% of the administrative staff. The major symptoms were optical disorders, headaches, and throat aches. All of them were mild cases, and we had only one case that required hospitalization. The chapel had the highest ratio of secondary contamination, where 38 out of 83 (45.8%) claimed some physical symptoms. The ICU operating room (38.7%) and the corridor (32.4%) followed. On the other hand, only 16.7% of the staff in the EMC diagnosis room, where the most seriously injured were accommodated, experienced secondary contamination. These results show that ventilation and the usage of masks can prevent medical personnel from being secondarily contaminated.

Operations in the Days Following Incident

- **Patients:** Except for one patient who had cerebral postresuscitation syndrome and remained unconscious, most of the inpatients were discharged within a week. Though we received new outpatients for a few days, all of them had minor injuries and did not need hospitalization. The EMC, the Internal Medical Department, the Optical Department, and the Psychiatric Department worked together to treat returning outpatients.
- **Payment:** Patients were reluctant to pay for treatment because they considered themselves victims, and it was unclear whether the expenses were covered by medical insurance. Therefore, we decided to suspend billing until all these matters could be cleared up. Also, because the patients were injured on their way to work, our administrative staff informed them that they could apply for workmen's compensation. In the end, most of the payment was covered by workmen's compensation.
- **Documentation:** We were asked to fill out an enormous amount of documents, such as medical certificates, applications for workmen's compensation, and statements to the Public Prosecutor's Office. Head doctors and administrative staff completed the work together.
- **Conference to report:** On April 17, one month after the incident, we held a conference to report the clinical cases that we observed at SLIH. We decided to do this because we thought we had a responsibility to quickly share our experience, given the large number of questions from the Japanese government and other medical facilities anticipating a third chemical attack following Matsumoto and Tokyo. The departments that had engaged in the treatment, mainly the Emergency Department, reported the patients' clinical symptoms, the results of check-ups, treatment, and progress. Though we were not able to provide proper publicity for the conference, 114 medical personnel from all over Japan attended. Later, we distributed a booklet over the Internet summarizing the reports presented at the conference.

Evaluation Communications

Despite the fact that the scope of the Tokyo Subway Sarin Incident was limited and did not damage medical facilities or communication systems, various pieces of essential information were not efficiently delivered to SLIH.

First, except for the initial TFD report indicating that there might have been an explosion in the subway system, the TFD and MPD gave us no information about what had occurred.

Without knowing what was happening, the decision to switch from normal emergency operations conducted by the EMC to emergency operations conducted by the entire staff was based only on our best guess. Canceling regular treatment for 2,000 outpatients is a difficult decision. We could have switched to emergency operation more smoothly if we had received information about the disaster.

Furthermore, we did not receive any information from official institutions about the hazard, incident, and responses of other hospitals. Though we had officers from TFD and MPD in the hospital, their role was to provide their headquarters with information from SLIH—such as the number of inpatients, their names, and the severity of their injuries. These officers did not supply us with any information that their headquarters had. Consequently, our primary information source was television news reports. Through phone calls with doctors at the other hospitals, we also gathered a small amount of information on how many patients other medical centers had accommodated and how they were treated, but we were not able to discern a complete picture for a few days.

The current emergency medical communication system allows hospitals to communicate only with an ambulance control center. Moreover, the information exchanged usually concerns one emergency case, not many. Furthermore, the information is limited to how a patient is treated in the ambulance, not in hospitals. If an event, such as the Tokyo Subway Sarin Incident, occurs in which patients outnumber ambulances, we could not obtain essential information about the patients under the current emergency medical communication system.

Patient Transportation

We found that two-and-a-half times more patients were transported from the station three kilometers away than from the nearest station, which had the largest number of patients. Also, far more patients came to the hospital on foot or by taxi and other privately owned cars than by ambulance. Even patients experiencing CPA were transported in privately owned cars.

We assume that these facts demonstrate that information concerning the incident sites and accommodation status at medical facilities was not communicated. When many people are injured within a short period, transportation by ambulance will not work effectively, making the use of taxis or privately owned cars necessary. We believe that we need to consider how to guide these cars to hospitals that can still accommodate patients without pushing incident sites into further turmoil.

Secondary Contamination of Medical Staff

We tried to prevent our medical staffs from being secondarily contaminated by requiring that all staff wear gloves and masks and insisting that patients' clothes be put into plastic bags. However, as noted previously, more staff was contaminated than we expected because of poor ventilation in public areas, SLIH's corridors, and especially the chapel. In the case of a chemical disaster, it is necessary to think about where to accommodate patients, keeping in mind not only space, but also ventilation.

Conclusions

There are two main reasons why we were able to respond effectively to the Tokyo Subway Sarin Incident. First, because the patients suffered only from sarin poisoning and most of them had minor injuries, we were able to standardize the treatment procedure. Second, because the incident occurred early in the morning before the normal treatment operations had started, we were able to reallocate resources to emergency operation relatively smoothly.

However, we also discovered several problems that we would not have even imagined had we not gone through the incident. In particular, it was stunning to see that so little information was delivered to the hospital. Considering that we relied on television news reports as our sole information source, it may be wise to think about how to use mass media as a communication tool between official institutions and medical facilities.

Based on the lessons we learned from the Tokyo Subway Sarin Incident, we believe that we need to immediately begin discussion on how to design the emergency medical system so that it allows hospitals to share essential information during a crisis.

RESOURCES

Figures

Figure 1: Outpatients and Inpatients since March 20

	The number of outpatients	The number of inpatients
March 20 (Mon)	640	111
March 21 (Tue)	116	31
March 22 (Tue)	319	10
March 23 (Tue)	204	5
March 24 (Tue)	90	3
March 25 (Sat)	40	2
March 26 (Sun)	1	2

Figure 2: Serious Injury Cases

	Age	Sex	Initial status	ChE*	Progress
Case 1	32	F	Miosis, CPA	N/A	Deceased
Case 2	21	F	Miosis, CPA	10	Deceased after 28 days
Case 3	21	F	Miosis, CPA	13	Discharged after 6 days
Case 4	55	M	Miosis, Convulsion, Consciousness disorder, Respiratory arrest	10	Discharged after 3 days
Case 5	27	M	Miosis, Convulsion, Consciousness disorder, Respiratory arrest	19	Discharged after 4 days

* cholinesterase, normally 100-250 U/l

Figure 3: Patient transportation to SLIH

On foot	174
Taxi	120
Privately owned cars	67
TFD cars	64
Ambulances	35
Patrol cars	7
Others	31

Citation

- Ishimatsu, Shinichi and Takasu, Nobukatsu. "Tokyo chikatetsu sarin jiken: Seiroka kokusai byoin no shinryo katsudo (The Tokyo Subway Sarin Incident: Emergency Medical Response by St. Luke's International Hospital)," *Kyukyu igaku* (Emergency Medicine). Oct. 1995, pp. 165-171.

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