Tokyo Sarin Attack 1995

Tareg Bey, MD, FACEP, ABMT, DEAA
Professor of Emergency Medicine
Department of Emergency Medicine
Director, International Emergency Medicine
University of California, Irvine, USA
The Tokyo Incident

• 3 million workers and students arrive into Tokyo via the subway
• Monday morning 0755 on March 20, 1995 during rush hour
• The terrorist group organized the release of Sarin into 5 subway cars on 3 separate subway lines
Timeline of Attack

• 0755 Diluted form of Sarin released
• 0816 St. Luke’s ED alerted
• 0828 First subway victim arrived to ED
  » C/O eye pain and dim vision
• 0920 approx. 500 additional patients had arrived; Hospital director activated hospital’s disaster plan
• Total patients at St. Luke’s ED = 640
• More than 100 doctors & 300 nurses and volunteers available to provide health care
The Incident

- Largest documented civilian exposure to nerve agent
- Total of 12 commuters killed *
- 2 deaths in the hospital
- 5,000 persons required emergency medical evaluation
- 640 persons presented to the hospital
- * Numbers may have increased.
Sarin

- Developed in the 1930s for use in warfare by the German Dr. Gerhard Schrader
- Potent organophosphate compound
- Blocks acetylcholinesterase effects at myoneural junction
- Sarin: schrader, Ambrose, Rudringer, van der Linde
Nerve Agents

• Are organophosphates
• Are similar to insecticides:
  – Malathion
  – Diazinon
  – Chlorpyrifos
Sarin

- Overstimulation of cholinergic receptors
- Effective in vapor form
- Lethal Dose: 1 mg
- Tokyo attack: diluted form of Sarin
Expected Symptoms

- Miosis
- Fasciculations
- Convulsions
- Weakness
- Respiratory insufficiency
- Decreased level of consciousness
Tokyo 1995

http://newsimg.bbc.co.uk/media/images/39504000.jpg/39504695_attack203.jpg

http://www.semp.us/_images/biots/Biot171PhotoA.jpg

http://www.npa.go.jp/hakusyo/h16/hakusho/h16/image/ph200025.png
Most prominent signs and symptoms of 111 moderate and severe cases

- Miosis 110 patients 99%
- Headache 83 patients 74.8%
- Dyspnea 70 patients 63.1%
- Nausea 67 patients 60.4%
- Eye pain 50 patients 45%
How did the Sarin Victims Arrive to St. Luke’s Hospital?

• 640 patients to the hospital
• 64 (10%) arrived by ambulance
• 35 (5.5%) arrived by minivans belonging to the Fire Defense Agency
• 541 (84.5%) arrived by nonmedical vehicles
Cases

- Of the 641 patients seen at St. Luke’s International Hospital on the day of the disaster, five were in critical condition.
- Three patients had cardiopulmonary arrest and two were unconscious and had respiratory arrest soon after arrival.
- Of these five critically ill patients, three were successfully resuscitated and able to leave on hospital day 6.
- One of the patient who had cardiopulmonary arrest did not respond to cardiopulmonary resuscitation (CPR) and died with findings of very bizzare miosis.
Decontamination of the Nerve Agents

- Outdoors is best
- Usually near ER
- Copious water
- Special drain considerations
- Hypochlorite not necessary
Tokyo 1995

• Transport of sick patient out of subway
• With PPE of rescue staff
• No PPE in the hospital

http://publicsafety.com/article/photos/1129126846021_chemical1.jpg
Tokyo: Hospital Response

• 5,500 victims
• 641 presented to St. Luke’s International Hospital
• No decontamination was the norm
• No EMS involvement for most patients
Tokyo Events – Video
Hospital Receiving Area
Nerve Agents - Therapy

• Blocks the enzyme acetylcholinesterase
• Protection: PPE, evacuated, undress, avoid cross contamination, off gassing?
• Decontamination
• Airway, ventilation, supportive care, (seizure control, suctioning, IV fluids)
• Antidotes (atropine, obidoxime, HI-6)
• Anticonvulsants (valium, midazolam)
Usual Treatment

• **Decontamination**
  • Anticholinergics
    – Atropine sulfate
  • Reverse block of acetylcholinesterase
    – 2-pyridine aldoxime methiodide (2-PAM)

• **Supportive treatment**
  – Ventilatory support

• **Resuscitative**
  – CPR, intubation
Categorization Of Victims- Triage

- MILD – only eye signs or symptoms
  » 528 patients (82.5%)
  » Released after 12 hrs of observation
- MODERATE – presence of systemic signs without needing mechanical ventilation
  » 107 patients (16.7%)
- SEVERE – require emergency ventilation
  » 5 patients (0.78%)
Examples When Early Detection Can Make a Difference

• Radiological: Radionuclides- N-95 respirators, type of decontamination, delay of decontamination early trauma care
• Chemical:
  - Mustard gas: Isobutyl rubber protection versus latex gloves
  - Sarin gas versus Soman or Tabun: Half-life, antidotes versus mass ventilation  --- Tokyo: Lack of PPE, difficulties with early detection
Key Points

• Detection, awareness
• PPE, protection
• Decontamination
• Mass treatment, proper triage of a chemical incident
• Chemical versus radiological versus biological triage
• Supportive Care and Antidotes
Technology
Example: Europe
Origin: Military Light Armored Vehicle (LAV) – Fuchs -

http://www.uebersetzerportal.de/bilder/fuchs-spuerpanzer.jpg
Technical Capabilities

• Automatic and continuous measurements (online measurements) in conjunction with geopositioning and storage of data –online graphic visualization-

• Measurement and transmission of meteorological data

• Soil, water and air sampling

• Data transmission to central dispatch
Standardized CBRN Explorers

• Uniformly equipped “CBRN Explorers” assure more timely and consistent analytic capabilities in all geographic areas during HAZMAT disasters.

• In the United States the fire departments’ HAZMAT teams and other agencies own a great variety of different nonstandardized analytical CBRN tools across the country
Dose Rate- Time (Location)
Rad-xy-Diagramm600

http://www.bbk.bund.de/cln_007/nn_400552/SharedDocs/Bilder/ABC-Schutz/RadxyDiagramm600.html
Mapping of a Dose Rate with GPS

http://www.bbk.bund.de/cln_007/nn_400552/SharedDocs/Bilder/ABC-Schutz/Karte_20ODL_20Bonn600.html
Examples Chemical Detection

Photoionization detector (PID), Ionmobility spectrometry (IOS):
Measurement of HAZMAT and chemical warfare agent

http://www.bbk.bund.de/cln_007/nn_400552/DE/02__Themen/08__ABCSchutz/01__ABCErkundung/02__Messtechnik/05__Ionenmobilitaetsspektrometer/Ionenmobilitaetspektrometer__node.html__nnn=true
Ionmobility Spectrometry: Rapid Alarm and Identification Device (RAID 1)

CWA
• Lewisite
• Sarin, Soman, Tabun, VX
• Sulfur and nitrogen mustard

Industry:
• Ammonia, cyanide, chlorine, chlorinated halogens, acetic acid, SO2, Toluene diisocyanate
Problems in Tokyo

- Delay in confirmation of the nature of toxic substance
- No personal protective equipment at hospital entrance
- Delay in organizing a mass casualty plan
- Poor ventilation in waiting area of ED
- Secondary contamination of medical staff
Tokyo: Hospital Response

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Summary

• For nerve agents avoidance of exposure is an important issue.
• Evacuation of closed environment is a key measure.
• Personal protective equipment
• Decontamination prevents further exposure and ongoing absorption with further toxicity.
• Supportive care saves lives.
• Antidotes: Atropine, obidoxime, benzodiazepines