Chemical and radiological terrorism: a perspective for GPs

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The second of three articles focusing on the roles GPs could play in dealing with the aftermath of a CBR incident describes the clinical effects of chemical and radiological agents that could be used in acts of terrorism and the appropriate initial treatment of affected people.

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The use of chemical and radiological agents in either a military or civilian scenario will, in the worst case scenario, quickly involve all the response services in the area and beyond. The media will give the incident massive coverage and, despite attempts to contain the incident and casualties within an area, hundreds of people will self-present to nearby hospitals while many others will flee and seek help elsewhere. As the attack is publicised further, many more ambulant patients will seek help, and even people not at risk will seek reassurance wherever they can.

Nerve agents, mustard gas and phosgene have been used in various wars since their first use in World War I, including in the Iran–Iraqi war in the 1980s. An example of a chemical being used against civilians is the release of the nerve gas sarin on the Tokyo subway by the Aum Shinrikyo cult in 1995. Complete chaos was caused, with 12 people dying and about 4000 being injured. Tokyo was insufficiently prepared for a large chemical disaster; the greatest problems encountered were correctly identifying the substance, a lack of education of medical staff, poor inter-service co-operation and collapse of communications.

Deliberate radiological contamination could be caused by violation of the safe operation of nuclear facilities, resulting in release of radioactivity, or direct release of radioactive substances into the environment, either from various industrial materials or from a 'dirty bomb'. The aims of an intentional radiological incident would be to cause damage to population health and the environment and to generate widespread fear and disruption.

It is therefore important that healthcare professionals have a basic general knowledge of chemical, biological and radiological (CBR) agents and disaster responses before an incident occurs. It is also essential that accurate information about the incident and the agent involved is widely available without delay once an incident has occurred so that the response is appropriate.

This article describes briefly the clinical effects of the various chemical and radiological agents that could be or already have been used in an intentionally aggressive manner, and the appropriate initial treatment of affected individuals. The potential mental health issues of CBR incidents are also discussed. The previous article in this series (*Medicine Today* 2003; 4(9): 62-64) covered the main principles of disaster response and triage, including the need for containment of incidents, decontamination and the use of personal protective suits, and the final article will cover biological terrorism.

Chemical agents

Chemical agents vary in their modes of action, their physical characteristics, the time they remain active in the environment (persistence) and their lethality.

The nerve agents sarin, tabun, soman and VX are liquid at ambient temperature but easily vaporised, making them easy to disseminate in a terrorist situation. They have a high lethality.

Blistering agents such as sulfur mustard are usually nonfatal but persist in the environment longer than most other chemical agents that might be used as

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weapons. They are, like the nerve agents, liquids that evaporate rapidly in a warm dry environment. Phosgene, a gas at ambient temperature, is an irritant similar to the mustard agents but does not cause true blisters and is more lethal.

Hydrogen cyanide, which can exist in gas or solid forms or in solution, has a high lethality and is quick acting but has a low persistence.

CS, an irritant that is used as a tear gas in outdoor situations by military and law enforcement agencies, has potential for use as a chemical weapon in confined areas because of the panic and disorientation it would cause. CS is a powder and has low lethality and low persistence.

Clinical effects of exposure

Nerve agents

Nerve agents penetrate the skin, conjunctivae and mucosal surfaces, and produce the cholinergic syndrome by inhibiting anticholinesterase. A mnemonic for the symptoms produced is BLUDGES (personal communication, Dr Andrew Finckh):

- Bronchorrhoea, bradycardia, bronchospasm
- Lacrimation
- Urination
- Defaecation
- Gastroenteritis–diarrhoea, colic
- Emesis
- Salivation.

Neuromuscular (nicotinic) and CNS effects also become evident.

The mainstay of treatment for patients who have been exposed to neurotoxins is immediate administration of an anticholinergic agent (atropine, 2 mg intravenously every few minutes until evidence of reversal of the clinical signs). Before this, of course, patients will have been moved out of the contaminated site to a well-ventilated area, and will have been decontaminated. Patients may also require early endotracheal intubation and physiological support. Pralidoxime (Pralidoxime Iodide Injection [PAM]) can be used for the nicotinic effects. Prophylactic prevention and active treatment of fitting (with benzodiazepines such as diazepam) may increase survival.

Sulfur mustard and phosgene

Sulfur mustard is an alkylating agent that causes severe skin blistering and severe damage to the eyes, airways, gastrointestinal tract and organs, producing symptoms two to 24 hours after exposure. After decontamination, treatment is as for major burns.

Phosgene is absorbed through contact with the eyes, causing immediate eye irritation, or by inhalation. Inhalation causes increased capillary permeabilty, resulting in severe pulmonary oedema a few hours later, and then acute respiratory distress syndrome. Treatment after decontamination is by physiological support: no antidote exists for phosgene.

Radiological incidents

Once it has been established that an incident has caused people to be exposed to radiation, the key questions to be asked are whether an individual has been exposed and if so, the type of radiation involved and the total dose received.

Radioactively contaminated materials will emit gamma, beta and alpha radiation in amounts varying with the radioactive source. Gamma radiation emitters may cause whole body irradiation. Beta emitters can produce serious burns and scarring if in prolonged contact with the skin. Alpha radiation does not penetrate the epithelium but is responsible for much internal damage if the emitting material is inhaled or ingested.

Signs and symptoms of exposure

Most medical practitioners will have some knowledge of the clinical spectrum of radiation illness, although acute radiation sickness would only be likely to be seen if the radiation dose was very large, such as after a nuclear explosion. Symptomatic treatment would be appropriate during the prodromal and latent stages of acute radiation syndromes, and manifest illness would require specialty treatment (see the box on this page).

The radiation dose from a dirty bomb would probably be relatively small and the primary health risk from such a bomb would be the trauma associated with being caught in the explosion itself, although there would be an increased incidence of cancer from long term

Course of acute radiation sickness

Prodromal stage

Nausea, vomiting and possibly diarrhoea (depending on total dose) within minutes or up to several days after exposure and lasting for minutes to days.

Latent stage

General malaise for a few hours to a few weeks.

Manifest illness

Symptoms are usually system predominant and last from hours to months. The three radiation syndromes are: bone marrow syndrome (occurring with lower radiation doses), gastrointestinal syndrome (occurring with moderate doses) and cardiovascular/central nervous system syndrome (occurring with higher radiation doses).

Recovery or death

Recovery can take several weeks to two years. Most patients who do not recover will die within several months of exposure.

exposure to residual radiation. The widespread fear and panic that would result from deliberate radiological contamination would have many psychological effects.

Decontamination

Specific treatments are involved in decontamination, which is the initial response to a radiological incident. Taking off outer clothing and shoes and washing skin and hair removes most of the radioactive dust and particles, reducing radioactive contamination by more than 90%.

Internal decontamination is reduced by the thorough cleaning of contaminated wounds, the use of chelation therapy to remove heavy metal radionuclides and radioiodine, and the use of gastric lavage, emetics, purgatives, laxatives and enemas to remove radioactive materials from the gastrointestinal tract.

Mental health effects

Given the obvious fear, grief and severe emotional stress involved in a CBR incident, mental health is an important area to be considered in planning a response to such incidents. Fear and panic is a way of dealing with the unknown but chaos and disorder can be reduced by providing timely, accurate and credible information to the population. The whole community, including first responders and healthcare providers, is likely to need at least some counselling, not just affected patients. Although few doctors are skilled in the field of mental health, they can be helped by the adaptating of the general principles of mental health care for use with large numbers of people.

The initial dilemma of diagnosing mental disturbance – organic, psychological or both – is very real. Chemical, biological and radiological agents that may be used in CBR incidents will all cause mental disturbance. In addition, the biological agents are likely to cause delirium, and specific biological agents will cause other mental health disturbances (such as botulism and viral encephalitis causing depression, and anthrax causing meningitis).

Conclusion

Whether or not they want to be involved, GPs will have important roles in the detection of and initial response to CBR incidents, terrorist or otherwise. General practice groups and divisions should, if they have not already done so, consider the risks in their environment and plan how GPs will contribute to a structured response, both individually and as part of a team. MT

Further reading

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