



Nuclear and Radiological Accidents

25

Luc Ronchi

25.1 What You Should Know [1–3]

The origin of these accidents is diverse: nuclear war, accident in an industrial site, transport accident, terroristic attack, and loss of a sealed radiological source.

There are pre-established preparedness plans (to face planned, emergency, and post-accident situations) for the public and for the concerned emergency services.

RAD risk does not give rise (except in massive irradiation) to immediate alerting symptoms.

It is imperative to protect all responders during the entire rescue and victim management process.

It is possible to have additional traumatic injuries (explosion, attack), which will interfere with the management of victims.

25.2 What You Should Understand

Radio-nuclear (RD) events bring about a wide range of consequences: from the explosion of a nuclear power plant (Chernobyl,

L. Ronchi (✉)
SFMC, Paris, France

Fukushima) to the observation of more or less deep musculocutaneous lesions on a localised skin surface in a small group of people (an out-of-use radiotherapy source left in a scrapyard in Brazil, cut up by scrap dealers and sold as a metal).

The radioactive isotopes of iodine and caesium as well as certain actinides (Uranium, Americium, Plutonium) are the most common radioactive agents detected in such accidents.

Irradiation is harmful due to the cytotoxicity it induces. Tissues vary in their susceptibility (haemopoietic and cerebral tissues are the most vulnerable). Irradiation affects cell structure (necrosis) and nuclear DNA (on the intermediate or long term, radiation-induced cancers develop).

Irradiation is not “contagious” i.e. not transmissible. Its quantification is performed by special techniques that are rarely used in acute incidents apart from industrial accidents.

Contamination occurs via the radioactive micro-particles emitted by the causative agent; they will attach to various media (hair, skin, mucosa) and form numerous micro-sources of irradiation that can generate the same effects as the initial source.

Thus, one can be contaminated even at a very far distance from the RN accident (consuming vegetables or animal products already contaminated by the radioactive cloud dispersed by wind e.g. Chernobyl accident). Contamination is transmissible, especially from victims to rescuers if no precautions are taken. Looking for contamination necessitates the use of a radiometer connected to an external probe to detect radiation emitted by radioactive particles present on the clothes or skin of the contaminated person. The device allows only to detect (hence alert) with no possible quantification.

Decontamination relies on four imperative measures:

- Not to over-contaminate the victim (apply strict stripping procedure);
- Not to allow external contaminants to enter the body (no foods or drinks are allowed before proper and effective decontamination, have victims wear protective masks (with filters) during the procedure);

- Not to allow contamination to spread into the environment (strict management of effluent);
- Not to contaminate responders.

The critical deterioration in health should drive attention towards the presence of one or multiple associated traumatic injuries. Unlike chemical poisoning (neurotoxic, cyanide), exposure to radioactive contamination cannot explain by itself circulatory or respiratory collapse, especially when there is a history of trauma or blast. Look for associated traumatic lesions.

25.3 What You Should Do

- Consider this exposure when circumstances suggest it, wait for results of special units intervention if in doubt;
- Wear special light decontamination PPE (TLD);
- Do not neglect physical examination which, combined with the accident circumstances, could indicate the need for emergency surgery;
- Have victims immediately wear facial masks to prevent the contaminants from entering their bodies via inhalation or ingestion (no drinks, no food, and no smoking);
- Spray water on clothes and skin in open air in order to avoid spread of contaminated particles;
- Proceed with victims disrobing following a specific technique (roll up the stripped clothes) to avoid spread of contamination;
- Rinse wounds with DTPA solution then wrap them up;
- Lead the victims through the decontamination chain except for urgent cases requiring immediate surgery who will be, after prior agreement, sent directly to the concerned wards. Wrapping the injured in double vinyl sheets and informing the receiving medical wards is vital so that the latter could take all standard measures to avoid dispersion of radioactive particles during hospitalisation. Medical and surgical emergencies are prioritised over decontamination;

- Order CBC (complete blood count) samples for all victims and repeat the test as needed (prognostic value of lymphocytes decay slope).

References

1. Vulgarisation site. <https://www.laradioactive.com>
2. Newsletter 800/SGDSN/PSE/PPS of 18/02/2011 related to the national doctrine of deployment of emergency and healthcare means to face a terroristic attack involving the use of radioactive materials
3. Gale RP, Armitage JO (2018) Are we prepared for nuclear terrorism? NEJM 378:1246–1254