



How to recognize and initially respond to an accidental radiation injury



Early erythema in the frontal and antelateral right side of the chest 5 days after the exposure to an iridium-192 source (185 GBq, 5 Ci) mounted in a pen-size source holder for industrial radiography which was placed to the pocket of the worker's overall and kept there for about two hours.



Early erythema 11 days after exposure.



Tense painful bulla of the left palm on day 20 evolving from erythema with early blistering which had appeared on day 10 after the initial contact for a few minutes with the iridium-192 source.



Deep infected ulcer on the upper medial part of right thigh six months after being unawarably exposed to a 164 GBq (4.4 Ci) cesium-137 source.



An ulcer in subacute stage and five ulcers following self-healing with depigmentation caused by being unawarably exposed 4-8 months earlier to the same 164 GBq (4.4 Ci) cesium-137 source (placed in a pocket of a trench coat used as a blanket).



Desquamation and skin necrosis 21 days after exposure. Note: the white areas correspond to silver bintment.

Since the discovery of ionizing radiation, knowledge of its detrimental effects has accumulated. Despite considerable development in the techniques of radiation safety, accidents may happen which might injure people.

Radiation sources are widely used in medicine, industry, agriculture and research. They might be lost, stolen, or otherwise out of proper control and this can lead to injuries to persons who came into contact with them.

Radiation accidents are rare. The statistics show that between 1944 and 1999 in 405 accidents worldwide, approximately 3000 persons were injured, with 120 fatalities (including the 28 Chernobyl victims). During the last few years the number of accidents and incidents involving radiation sources has increased. Often the victims of such occurrences are unaware that they may have been exposed to radiation. The medical consequences of these situations might first be observed by general practitioners (GPs), dermatologists, haematologists, specialists in infectious diseases and other medical doctors, but diagnosis may not be immediately obvious. Lack of knowledge about the consequences of exposure to radiation is one of the main reasons why many accidental injuries are not recognized sufficiently early for the most effective treatment. Health authorities and medical personnel therefore need to be prepared for such an eventuality.

This leaflet is intended to inform physicians — mainly GPs — and medical students on how to recognize a possible radiation injury. It is important to note that radiation injury has no special signs and symptoms. However, the combination of some of them may be typical of radiation injury.

What are the types of radiation exposure that might arise from an accident?

The exposure can be

- external to the body, in which case it may be to the whole body or limited to larger or smaller parts of the body, or
- internal due to contamination with radioactive materials, if ingested, inhaled, or deposited in wounds.

Exposure can be acute, protracted or fractionated. It can occur alone, or be combined with other injury, such as trauma, thermal burn, etc.

Recognizing radiation injuries by their clinical manifestations

Following a high-level accidental exposure to radiation, injuries evolve over time in distinct phases. The length and time of the occurrence of the phases depend on the dose. Low doses do not produce observable effects.


A typical course following a whole body exposure to a source of penetrating radiation involves an initial prodromal phase with symptoms such as nausea, vomiting, fatigue and possibly fever and diarrhoea, followed by a latent period of varying lengths. A period of illness follows, characterized by infection, bleeding and gastrointestinal symptoms. Problems in this period are due to deficiencies of cells of the haematopoietic system, and, with higher doses, to loss of cells lining the gastrointestinal tract.

A local exposure, depending on dose, can produce signs and symptoms in the exposed area such as erythema, oedema, dry and wet desquamation, blistering, pain, necrosis, gangrene or epilation. Local skin injuries evolve slowly over time — usually weeks to months — may become very painful and are difficult to treat by usual methods.

Partial body exposures result in a combination of varying symptoms as mentioned above, the type and severity of which depend on the dose to and volume of the exposed part of the body. Additional symptoms may be related to location of the tissues and organs involved.

There are usually no early symptoms associated with internal contamination unless the intake has been very high. If this has occurred, it will normally be obvious to the person concerned. Therefore, the focus of this leaflet is on external exposure resulting from radiation sources.

What are the main questions to ask the patients (when taking detailed anamnesis of a suspected radiation exposure) ?

- Did you find or come into physical contact with an unknown metallic object? If yes, when, where and how?
- Did you see a sign like this  (eg. on its package)?
- Were there similar symptoms among family members and colleagues at the same time?
- Do you know how you received this injury?

What should the physician do if radiation injury is suspected?

- If the patient has a conventional injury or illness, save life and treat as normally required. Note that radiation does not produce life threatening early symptoms.
- Be aware that a radiation injured person does not present a health risk to the doctor.
- Do not touch any unfamiliar object in the patient's possession and move staff and patients to another room until the nature of the object has been determined by a radiation protection specialist.
- If contamination is suspected, avoid spread of material by using isolation procedures. Contact a radiation authority or radiation protection service for monitoring.
- Do a prompt complete blood count, repeated in 4 to 6 hours. Look for a drop in the absolute lymphocyte count if exposure was recent. If the initial white cell and platelet count is abnormally low, consider the possibility of an exposure a few days to weeks earlier. Additional blood counts might be needed.
- Notify health authority and radiation protection service if radiation injury is diagnosed or suspected.

Differential diagnosis of radiation injury

Consider radiation injury in a differential diagnosis if the patient presents with:

- A description of circumstances that might have led to a radiation exposure (eg. work with scrap metal).
- Nausea and vomiting, especially if accompanied by erythema, fatigue, diarrhoea or other symptoms not explained by other causes, such as food poisoning, intestinal infections or allergy.
- Skin lesions without knowledge of a chemical or thermal burn, or insect bite, or history of skin disease or allergy, but with desquamation and epilation in the exposed area further to erythema having occurred 2-4 weeks previously .
- Epilation or bleeding problems (such as petechia, gingival or nose bleedings) with a history of nausea and vomiting two to four weeks previously.

Some recommendations on your preparedness

- Have available in advance the telephone numbers of the health authorities and radiation protection service (and keep them up-to-date).
- Rely on professional information from the national health authority and radiation protection service and assist in the implementation of their recommendations.

Further readings

- IAEA-WHO: Diagnosis and Treatment of Radiation Injuries. Safety Report Series, No. 2, IAEA, Vienna, 1998.
- IAEA-WHO: Planning the Medical Response to Radiological Accidents. Safety Report Series, No. 4, IAEA, Vienna, 1998.
- IAEA-ILO-WHO: Health Surveillance of Persons Occupationally Exposed to Ionizing Radiation. Safety Report Series, No. 5, IAEA, Vienna, 1998.