

Occupational Radiation Protection during High Exposure Operations

Medical Management of Radiological Casualties

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1. Introduction

Medical management of radiological casualties is important for the emergency workers to understand and therefore relieve their anxiety in relation to medical treatment of high exposure or intense contamination.

- The first priority of handling victims is to stabilize their physical conditions even if they are contaminated or exposed to radiation.
- Radiological problems of radiation exposed or contaminated persons can be dealt with any necessary urgent conventional medical treatment.
- Even the highly exposed victims have time before manifesting illness due to exposure after the prodromal syndrome where vomiting is possible within hours.
- The latent phase becomes shorter with increasing dose and is at least for two days even in cases of severe exposure. It is necessary to estimate the exposed dose for the prognosis and future treatment.

2. Basis of medical management of radiation injury

- **Deterministic effect:**

The radiation symptoms or signs can be modified by some treatments after irradiation.

- **Stochastic effect:**

There are no treatment to change the occurrence probability of the effects.

In case of contamination, radiation exposure continues while the radioactive materials are existing on the body surface or in the body. Early decontamination can reduce the radiation dose to the body.

This principle is true both for surface and internal contamination.

3. Decontamination of skin and hair

If contamination is found, it should be removed as soon as possible and as much as possible.

First step for the decontamination is removal of clothes. It stands to reason that clothing typically covers large part of the body, therefore proper removal of the clothing is likely to significantly decrease the amount of radioactive material on the body surface.

- Skin contamination is wiped and rinsed with water. During this procedure, the operators should exercise caution not to create a skin scratch or an abrasion.
- Contaminated hair needs to be wiped or washed with water. It is important to avoid drainage water to be splashed around the mouth, the nose, or the eyes. If decontamination is not effective enough, cutting the hair can be an option.

4. Management of contaminated skin injury

Most of radionuclides are not absorbed through a normal skin, with an exception of tritium. However, radionuclides can be absorbed through injured parts, or wounds.

The radionuclides in wounds need generally to be removed as soon as and as much as possible to reduce internal contamination.

Regular procedure of the wound decontamination is irrigation with normal saline solution or water.

5. Management of internally deposited radionuclides

Main aspects of the procedure for the removal of internally deposited radionuclides are:

Identification of radionuclides and rough dose assessment of the internal contamination is desirable to be obtained before starting treatment for internal contamination. At least one of the following tests should be conducted:

- Nose swap test;
- Body surface contamination screening, especially wounds;
- Measurements by a whole body counter.

When the above mentioned tests do not indicate contamination, but internal contamination is still suspected, it is necessary then to carry out bio-analyses for the identification and quantification of radionuclides in the body with urine, faeces and blood samples.

5. Management of internally deposited radionuclides

Some clinical decisions to initiate or not to initiate decontamination, even without the confirmatory tests at hand, are based on:

- Radiotoxicity of the radionuclides;
- Radioactive concentration in the air where the workers was present;
- Toxicity of the drug to be used for “decorporation”

Removal of internal contamination is not an easy task. It is better to decide based on estimated dose if possible, efficiency of removal and adverse effect of each treatment.

There is only a limited number of decorporation agents which could apply to certain radionuclides (DTPA, Prussian Blue,..).

6. Diagnosis and medical management of radiation syndromes

Cutaneous radiation syndrome (CRS)

Especially for non-uniform irradiation, skin injury becomes main concern in some cases.

Stage / symptoms	Dose range [Gy]	Time of onset [day]
Erythema	3 - 10	14 - 21
Epilation	>3	14 - 18
Dry desquamation	8 - 12	25 - 30
Moist desquamation	15 - 20	20 - 28
Blister formation	15 - 25	15 - 25
Ulceration (within skin)	>20	14 - 21
Necrosis (deeper penetration)	>25	>21

Deterministic Effects



Radiation burn; from the Radiological Accident in Yanango, IAEA, 2000

Deterministic Effects after Chernobyl



- Chernobyl experience
- ARS and radiation burns



6. Diagnosis and medical management of radiation syndromes

Cutaneous radiation syndrome (CRS)

Local radiation injury results in skin lesions quite similar to thermal burns. However, thermal burns are different from “radiation burns” in the following aspects:

- Radiological burns are dynamic; their temporal and spatial evolution is unpredictable and even relatively independent of the initial clinical evolution;
- Patient do not present initial shock;
- Pain is not immediate in local radiation injury, but when the pain it appears later it is very severe and more resistant to drug action;
- It is a prognostic symptom which indicates a new wave of clinical recurrence.

6. Diagnosis and medical management of radiation syndromes

Acute Radiation Syndrome (ARS)

A combination of clinical signs and symptoms may occur over a period of hours to weeks due to significant partial-body or whole body exposure over 1 Gy as various tissues and organs may be injured. ARS has 4 phases:

- 1) an initial or prodromal phase occurring during the first few hours after exposure;
- 2) a latent phase, which becomes shorter with increasing dose;
- 3) a manifest phase of clinical illness. As a rule, the higher the dose, the time of onset of all three phases and their duration shortens while the prodromal and the manifest illness phase become more severe
- 4) the death or recovery of health conditions

6. Diagnosis and medical management of radiation syndromes

Acute Radiation Syndrome (ARS)

As a part of diagnosis, the radiation type should be identified and the received dose should be estimated by biological or physical methods.

Dose assessment method for external exposure

	Biological methods	Physical methods
Typical methods	<ul style="list-style-type: none">• Clinical symptoms• Blood samples incl. lymphocyte count• Chromosome analysis	<ul style="list-style-type: none">• Reconstruction• Work environment assessment• Personal dosimeter• Electron Spin Resonance (ESR)

7. Psychological support for patients

Appropriate officials at the national and local levels need to perform the actions needed to arrange psychological support. These actions are to be planned at the stage of preparedness.

When carrying out medical treatment of exposed or contaminated victims, medical staff as well as some relevant persons who come into contact with the patients should always consider psychological aspects of the patients as well as their family members.