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Biological Radiation hazards

Seventh Lecture

Third Stage

By
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Early effect of radiation exposure

Radiation has been described as a double edged sword. On the one hand, radiation itself is a useful tool for research; medical diagnosis and therapy, and on the other hand, radiation exposures, especially at high levels, can lead to increased frequencies or severities of various adverse health effects.

Radiosensitivity is the relative susceptibility of cells, tissues, organs, organisms, or other substances to the injurious action of radiation. In general, it has been found that cell radiosensitivity is directly proportional to the rate of cell division and inversely proportional to the degree of cell differentiation.

To produce a radiation response in humans within a few days to months, the dose must be high, such a response is called an **early effect of radiation exposure**. Early radiation responses are described as **deterministic**, those that exhibit increasing severity with increasing radiation dose. The sequence of events that follow high-level radiation exposure leading to death within days or weeks is called the **acute radiation syndrome**

There are three separate syndromes that are dose related and that follow a rather distinct course of clinical responses.

These syndromes are;

1. Hematologic death
2. Gastrointestinal (GI) death
3. Central Nervous System (CNS) death

Acute Radiation Syndrome progresses in the following stages:

1. Prodromal Period

2. Latent Period

3. Manifest Illness Stage

4. Recovery or Death

1- Prodromal Period

consists of acute clinical symptoms that appear within minutes to hours of total body exposure to the radiation doses of approximately (1- 2 Gy) and may last from a few hours to a couple of days

2- Latent Period

After the period of initial radiation sickness, a period of apparent wellbeing occurs, which is called the **latent period**. Symptoms follow the latent period when the individuals are exposed in the lethal range (approximately 2-5 Gy, appear in weeks) or the supra-lethal range (more than 5 Gy, appear in hrs or less).

3- Manifest Illness Stage

In this stage the symptoms depend on the specific syndrome and last from hours up to several months. This phase reflects the clinical picture specifically associated with the radiation injury. The possible manifestations of this stage are largely dependent on the dose received.

4- Recovery or Death

Most patients who do not recover will die within a few to several months of exposure. The recovery process lasts from several weeks up to two years. With adequate medical care, recovery is likely at whole-body doses below 8 Gy. Death appears to be inevitable above 10 Gy.

1. Hematologic syndromes (2 – 10 Gy)

Prodromal Period: nausea, vomiting and diarrhea develops, with time of onset from later than 1 hour to about 24 hours after exposure and may persist for several days.

Latent period lasts up to a month, relatively asymptomatic except for some fatigue and weakness.

Manifest Illness period, characterized by fever, systemic and localized infections, sepsis, and hemorrhage.

Recovery period begins in 2 to 4 weeks, but as long as 6 months may be required for full recovery.

Death may occur as a result of generalized infection, electrolyte imbalance, and hemorrhage.

Mean Survival Time is 10 to 60 days

2. Gastrointestinal (GI) Syndrome (10 – 50 Gy)

Prodromal Period: Severe nausea and vomiting with watery diarrhea and cramps develops within hours after exposure and may persist for hours to as long as a day.

Latent Period of 3 to 5 days follows, during which no symptoms are present.

Manifest Illness: Return of severe diarrhea, vomiting with fever; progression to bloody diarrhea, shock and death without aggressive medical intervention may occur within 3 to 5 days.

Mean Survival Time is 4 to 10 days.

3. Central Nervous System (CNS) (> 50 Gy)

Prodromal Period: Nausea, vomiting and burning sensation in the skin within a few minutes of exposure.

The patient become nervous and confused with loss of vision, balance and consciousness within the first hour.

Latent Period: Lasts up to 12 hours, during which earlier symptoms disappear.

Manifest Illness: Symptoms of prodromal stage return but are more severe. The person becomes disoriented; loses muscle coordination; has difficulty breathing; may develop convulsive seizures; loss of equilibrium, ataxia and lethargy; lapses into coma; and dies.

Mean Survival Time is 0 to 3 days.