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RADIATION SICKNESS

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Radiation and radio-activity play a huge role in mankind development But it has a negative side, such as harmful influence on human body. We are going to consider radiation sickness.

Radiation sickness is generally associated with acute (a single large) exposure. Nausea and vomiting are usually the main symptoms. The amount of time between exposure to radiation and the onset of the initial symptoms may be an indicator of how much radiation was absorbed. Symptoms appear sooner with higher doses of exposure. The symptoms of radiation sickness become more serious (and the chance of survival decreases) as the dosage of radiation increases. A few symptom-free days may pass between the appearance of the initial symptoms and the onset of symptoms of more severe illness associated with higher doses of radiation. Nausea and vomiting generally occur within 24–48 hours after exposure to mild (1–2 Gy) doses of radiation. Headache, fatigue, and weakness are also seen with mild exposure. Moderate (2–3.5 Gy of radiation) exposure is associated with nausea and vomiting beginning within 12–24 hours after exposure. In addition to the symptoms of mild exposure, fever, hair loss, infections, bloody vomit and stools, and poor wound healing are seen with moderate exposure. Nausea and vomiting occur in less than 1 hour after exposure to severe (3.5–5.5 Gy) doses of radiation, followed by diarrhea and high fever in addition to the symptoms of lower levels of exposure. Very severe (5.5–8 Gy of radiation) exposure is followed by the onset of nausea and vomiting in less than 30 minutes followed by the appearance of dizziness, disorientation, and low blood pressure in addition to the symptoms of lower levels of exposure. Severe exposure is fatal about 50% of the time.

Longer term exposure to radiation, at doses less than that which produces serious radiation sickness, can induce cancer as cell-cycle genes are mutated. If a cancer is radiation-induced, then the disease, the speed at which the condition advances, the prognosis, the degree of pain, and every other feature of the disease are not functions of the radiation dose to which the sufferer is exposed. In this case, function of dose is the probability chronic effects will develop.

Since tumors grow by abnormally rapid cell division, the ability of radiation to disturb cell division is also used to treat cancer (see radiotherapy), and low levels of ionizing radiation have been claimed to lower one's risk of cancer (see hormesis).

External exposure is exposure which occurs when the radioactive source (or other radiation source) is outside (and remains outside) the organism which is exposed. Below are a series of three examples of external exposure.

A person who is treated for cancer by either teletherapy or brachytherapy. While in brachytherapy the source is inside the person it is still external exposure because the active part of the source never comes into direct contact with the biological tissues of the person.

One of the key points is that external exposure is often relatively easy to estimate, and the irradiated objects do not become radioactive (except for a case where the radiation is an intense neutron beam which causes activation of the object). It is possible for an object to be contaminated on the outer surfaces, assuming that no radioactivity enters the object it is still a case of external exposure and it is normally the case that decontamination is easy (wash the surface).

Internal exposure occurs when the radioactive material enters the organism, and the radioactive atoms become incorporated into the organism. Below are a series of examples of internal exposure.

The exposure caused by 40K present within a normal person.

The exposure to the ingestion of a soluble radioactive substance, such as 89Sr in cows' milk.

A person who is being treated for cancer by means of an open source radiotherapy method where a radioisotope is used as a drug. A review of this topic was published in 1999. Because the radioactive material becomes intimately mixed with the affected object it is often difficult to decontaminate the object or person in a case where internal exposure is occurring. While some very insoluble materials such as fission products within a uranium dioxide matrix might never be able to truly become part of an organism, it is normal to consider such particles in the lungs as a form of internal contamination which results in internal exposure. The reasoning is that the particles have entered via an orifice and can not be removed with ease from what the lay person (non biologist) would regard as within the animal. It is important to note that in a strictly topological sense, the contents of the digestive tract and the air within the lungs are outside the body of a mammal (whereas, for instance, the abdominal cavity is topologically inside the mammalian body).

Nuclear warfare and bomb tests are more complex because a person can be irradiated by at least three processes. The first (the major cause of burns) is not caused by ionizing radiation.

Thermal burns from infrared heat radiation

Beta burns from shallow ionizing beta radiation (this would be from fallout particles; the largest particles in local fallout would be likely to have very high activities because they would be deposited so soon after detonation and it is likely that one such particle upon the skin would be able to cause a localized burn); however, these particles are very weakly penetrating and have a short range.

Gamma burns from highly penetrating gamma radiation. This would likely cause deep gamma penetration within the body, which would result in uniform whole body irradiation rather than only a surface burn. In cases of whole body gamma irradiation (circa 10 Gy) caused by accidents involving medical product irradiators, some of the human subjects have developed injuries to their skin between the time of irradiation and death.

There is also the risk of internal radiation poisoning by ingestion of fallout particles.

Prevention

The best prevention for radiation sickness is to minimize the dose suffered by the human, or to reduce the dose rate.

Distance

Increasing distance from the radiation source reduces the dose according to the inverse-square law for a point source. Distance can be increased by means as simple as handling a source with forceps rather than fingers.

Time

The longer those humans are subjected to radiation the larger the dose will be. The advice in the nuclear war manual entitled "Nuclear War Survival Skills" published by Cresson Kearny in the U.S. was that if one needed to leave the shelter then this should be done as rapidly as possible to minimize exposure.

In chapter 12 he states that "Quickly putting or dumping wastes outside is not hazardous once fallout is no longer being deposited. For example, assume the shelter is in an area of heavy fallout and the dose rate outside is 400 R/hr enough to give a potentially fatal dose in about an hour to a person exposed in the open. If a person needs to be exposed for only 10 seconds to dump a bucket, in this 1/360th of an hour he will receive a dose of only about 1 R. Under war conditions, an additional 1-R dose is of little concern."

In peacetime, radiation workers are taught to work as quickly as possible when performing a task which exposes them to radiation. For instance, the recovery of a lost radiography source should be done as quickly as possible.

Reduction of incorporation into the human body

Potassium iodide (KI), administered orally immediately after exposure, may be used to protect the thyroid from ingested radioactive iodine in the event of an accident or terrorist attack at a nuclear power plant, or the detonation of a nuclear explosive. KI would not be effective against a dirty bomb unless the bomb happened to contain radioactive iodine, and even then it would only help to prevent thyroid cancer.

Fractionation of dose

It has been found in radiation biology experiments that if a group of cells are irradiated, then as the dose increases, the number of cells which survive decreases. It has also been found that if a population of cells is irradiated, then set aside for a length of time before being irradiated again, the radiation causes less cell death. The human body contains many types of cells and a human can be killed by the loss of a single type of cells in a vital organ. For many short term radiation deaths (3 days to 30 days), the loss of cells forming blood cells (bone marrow) and the cells in the digestive system (microvillus which form part of the wall of the intestines are constantly being regenerated in a healthy human) causes death.

In the graph below, dose/survival curves for a hypothetical group of cells have been drawn, with and without a rest time for the cells to recover. Other than the recovery time partway through the irradiation, the cells would have been treated identically.

Treatment

Treatment reversing the effects of irradiation is currently not possible. Anaesthetics and antiemetics are administered to counter the symptoms of exposure, as well as antibiotics for countering secondary infections caused by the resulting immune system deficiency.

There are also a number of substances used to mitigate the prolonged effects of radiation poisoning, by eliminating the remaining radioactive materials, post exposure

In the case of a person who has had only part of their body irradiated then the treatment is easier, as the human body can tolerate very large exposures to the non-vital parts such as hands and feet, without having a global effect on the entire body. For instance, if the hands get a 100 Gy dose which results in the body receiving a dose (averaged over the entire body) of less than 1 Gy then the hands may be lost but radiation poisoning may not occur. The resulting injury would be described as localized radiation burn.

As described below, one of the primary dangers of whole-body exposure is immunodeficiency caused by the destruction of bone marrow and consequent shortage of white blood cells. It is treated by maintaining a sterile environment, bone marrow transplants (see hematopoietic stem cell transplantation), and blood transfusions.

Experimental treatments designed to mitigate the effect on bone marrow

Neumune, an androstenediol, was introduced as a radiation countermeasure by the US Armed Forces Radiobiology Research Institute, and was under joint development with Hollis-Eden Pharmaceuticals until March, 2007. Neumune is in Investigational New Drug (IND) status and Phase I trials have been performed.

Some work has been published in which Cordyceps sinensis, a Chinese Herbal Medicine has been used to protect the bone marrow and digestive systems of mice from whole body irradation.

Recent lab studies conducted with bisphosphonate compounds have shown promise of mitigating radiation exposure effects.

Thus, radiation sickness not so is dangerous, it does not spoil people, it is possible to recover. But it is necessary to be cautious because radiating waves are invisible.