Radiation, Fear, and Common Sense Adaptations in Patient Care

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KEYWORDS

• Radiation • Ionizing radiation • Contamination • Exposure • Fear • Safety
• Adaptations in nursing care

KEY POINTS

- Lack of understanding of the nature of ionizing radiation has resulted in fear among health care providers regarding the care of patients contaminated with radioactive material.
- Such fear and misunderstanding can lead to unnecessary compromises in patient care.
- Caregiver and patient safety is ensured by an understanding of the basic science of radiation and common sense alterations in normal nursing technique.

FEAR AND ALL HAZARDS

Appropriate fear may limit the spread of a deadly disease.[1] The outbreaks of the Ebola virus have rightly rekindled fears of biological agents. CNN quoted the World Health Organization as saying that 416 medical caregivers had contracted the disease with 233 dying.[2] Fear of contracting Ebola by cross contamination is well founded. In 1995, the sarin nerve agent attack in Tokyo generated widespread fear about the dangers of chemical terrorism. This event became a watershed for warnings about imminent attacks and the need for mass casualty chemical training.[3] The need to be prepared for "all hazards" has led many hospitals to adopt "Level A" precautions for all chemical, biological, or radiation events.[3]

However, this level of fear is not appropriate in the case of a properly managed radiation event. The most likely accident results from a mishandled radiation source or an injury occurring in a contaminated work area.[4] For example, in 1987, an abandoned radioactive medical source was broken open by individuals in search of valuable scrap material in Goiania, Brazil. As a result, 249 people were contaminated with Cesium137. More than 100 were internally contaminated and 20 people had to be

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hospitalized to treat the effects of high radiation exposure. Four of these people died.[5] The medical staff and public responses were marked by fear and panic. Some patients were isolated in a ward for 24 hours without food and water. One patient was left overnight in an ambulance outside the hospital.[6] A team of physicians from the National Nuclear Energy Commission arrived and began working with little support from the health care community. Local training was provided and some staff did volunteer for treatment team duties. Even so, the fear of radiation was so profound that many staff members still refused and even called the volunteers "suicidal."[7]

WHAT IS RADIATION?

Radiation is energy transmitted through a medium. Examples are sound, light, radio waves, and micro waves. These are not ionizing radiations.

Ionizing radiation has enough energy to strip electrons from the outer shells of atoms, thus creating an ion and making the atom more chemically reactive with its neighbors. These free radicals may result in indirect damage to living tissue.[8] In some instances, radiation may cause a break in the DNA strand of a living cell. This direct damage may make it impossible for the cell to multiply, thus causing cell death. It is possible that DNA damage may cause a mutation that is passed on to successive generations, thus increasing the chances of cancer at some future point.[8] It should be noted that our bodies are well adapted to repairing radiation damage. We live in a universe in which radiation is everywhere. It is in the dirt, in food, in air, and throughout the universe as cosmic rays.[9] The point of radiation safety is to prevent exposure to an amount of radiation that would overwhelm our natural repair mechanisms.

An element is determined by the number of protons in the nucleus. If the ratio of neutrons to protons is not stable the atom will release radiation as it decays to a stable state.[8] For example, stable Iodine (I-127) has 53 protons and 74 neutrons. But Iodine131 has 4 more neutrons, is unstable and emits radiation. Radioactive Iodine is still chemically the same as stable Iodine. The chemical nature of any material is unaffected by the fact that it is radioactive.

AN ATOM MAY DECAY IN DIFFERENT WAYS

Alpha radiation is the emission of an alpha particle from the nucleus. An alpha particle consists of 2 protons and 2 neutrons. This strong 2^+ charge means alpha radiation gives up its energy quickly. It can only travel centimeters in air and is easily shielded, even by a piece of paper.[10] Alpha radiation cannot penetrate intact skin and is not an external threat. But if an alpha-emitting material were internalized it would be in immediate contact with living cells and would be a threat. A primary goal is to prevent or minimize internalization. Examples of alpha-emitting materials are Plutonium 238, Americium 241, and Polonium 210.[11,12]

Beta radiation is the emission of a beta particle (electron) from the nucleus of the atom. Beta radiation is more penetrating than alpha radiation, and can travel up to a meter in air or cause radiation damage to the skin. It cannot penetrate internal organs or bone marrow. Eyeglasses and heavier clothing are sufficient shielding for most beta radiation. An example of a beta-emitting material is Strontium 90.[11,12]

Gamma radiation is not a subatomic particle but pure energy (measured as "photons"). It is less ionizing and, therefore, more penetrating than alpha or beta radiation. Gamma radiation travels many meters in air and requires feet of concrete and inches of lead for shielding. This makes it an external threat in sufficient doses. Gamma rays have a wide variety of energies that are specific to the given isotope, its own finger print. An unknown gamma emitter can be identified by using a gamma spectrometer.