AL- Mustaqpal University

Science College

Dep. Medical Biotechnology

Second Stage

Lec 10

Radiation Doses

Interpretation and Analysis

of

The Amount of Radiation Exposure

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Radiation is energy that moves from one place to another in a form that can be described as waves or particles. We are exposed to radiation in our everyday life. Some of the most familiar sources of radiation include the sun, microwave ovens in our kitchens and the radios we listen to in our cars. And in physics, radiation is the emission or transmission of energy in the form of waves or particles through space or a material medium.

BACKGROUND ON DOSE ASSESSMENT AND DOSE RECONSTRUCTION

When ionizing radiation interacts with the human body it transfers part or all of its energy to the molecules and cells of body tissues. The response of these tissues to the deposition of energy in terms of physical, chemical, and biological changes is dependent on the amount of energy deposited per unit mass of tissue, or absorbed dose . **The quantity absorbed dose** (D) is defined as **the mean energy imparted by ionizing radiation per unit mass at a point of interest.**

The unit of absorbed dose is **J/kg**, and its special name is the **gray (Gy).** Although defined as a point quantity, absorbed dose usually represents an average over some finite volume or mass, such as the mass of the thyroid or the volume of red bone marrow distributed in the entire body. When the absorbed dose has approximately the same value for all organs and tissues of the body, as is the case for direct radiation[1] from energetic gamma rays or internal irradiation from inhalation or ingestion of cesium-137, it is common to use the term whole-body absorbed dose .

Adiation dose refers to the amount of ionizing radiation energy absorbed by a substance, such as biological tissue, measured in grays (Gy). It is calculated based on the energy absorbed in 1 kg of material, with different types of radiation having varying effects and weighting factors.

Radiation Dose

What is radiation dose?

A dose of medical **radiation** is not like a dose of medicine. When it comes to radiation dose, there are different types of and units of measurement. Radiation dose is a complicated topic.

Why are there different ways to measure a dose of radiation?

When you think of a dose of medication, you think of an absolute measurement of the quantity you take. But radiation isn't measured by the quantity you take.

Radiation from medical examinations is similar to sunlight. The effect of sunlight on the skin depends on the light's intensity and how long a person stays in it.

Sunlight Effect Factors :

- Intensity
- Length of exposure
- Sensitivity of the skin

People often describe their level of sun exposure based on the effect it has on their skin. Friends may say "You got a lot of sun." Or, "You're red; that must hurt." They are gauging the amount of sunlight, to which you were exposed, by what they see.

Likewise, a radiation dose will tell us about an effect the radiation has on tissue. Radiation dose can be measured a number of ways.

Radiation Doses

What these different doses can tell us:

1. **Absorbed dose** is used to assess the potential for biochemical changes in specific tissues.
2. **Equivalent dose** is used to assess how much biological damage is expected from the absorbed dose. (Different types of radiation have different damaging properties.)
3. **Effective dose** is used to assess the potential for long-term effects that might occur in the future.

What are x-rays and what do they do ?

X-rays are a form of energy – like light and radio waves. X-rays are also called radiation. Unlike light waves, x-rays have enough energy to pass through your body. As the radiation moves through your body, it passes through bones,

tissues, and organs differently. This allows a radiologist to create images of them. The radiologist is a specially trained doctor who can examine these images on a computer display. X-rays allow the radiologist to see the structures in your body in very fine detail.

X-ray exams provide valuable information about your health and help your doctor make an accurate diagnosis. Your doctor may use x-rays to help place tubes or other devices in your body or to treat disease.

Measuring radiation dosage

When radiation passes through the body, some of it is absorbed. The x-rays that are not absorbed are used to create the image. The amount the patient absorbs contributes to the patient's radiation dose. Radiation that passes through the

body does not contribute to this dose. The scientific unit of measurement for whole body radiation dose, called "effective dose," is the **millisievert (mSv)**. Other radiation dose measurement units include rad, rem, roentgen, sievert, and gray.

Doctors use "effective dose" when they talk about the risk of radiation to the entire body. Risk refers to possible side effects, such as the chance of developing a cancer later in life. Effective dose considers how sensitive different tissues are to radiation. If you have an x-ray exam that includes tissues or organs that are more sensitive to radiation, your effective dose will be higher. Effective dose allows your doctor to evaluate your risk and compare it to common, everyday sources of exposure, such as natural background radiation.

Naturally occurring "background" radiation

We are exposed to natural sources of radiation all the time. According to recent estimates, the average person in the U.S. receives an effective dose of about 3 **mSv** per year from natural radiation, which includes cosmic radiation from outer space. These natural "background doses" vary according to where you live.

People living at high altitudes such as Colorado or New Mexico receive about 1.5 mSv more per year than those living near sea level. The largest source of background radiation comes from radon gas in our homes (about 2 mSv per year). Like other sources of background radiation, the amount of radon exposure varies widely depending on where you live.

To put it simply, the amount of radiation from one adult chest x-ray (0.1 mSv) is about the same as 10 days of natural background radiation that we are all exposed to as part of our daily living.

Benefit versus risk

The risk associated with medical imaging procedures refers to possible long-term or short-term side effects. Most imaging procedures have a relatively low risk. Hospitals and imaging centers apply the principles of ALARA (As Low As Reasonably Achievable). This means they make every effort to decrease radiation risk. It is important to remember that a person is at risk if the doctor cannot accurately diagnose an illness or injury. Therefore, it could be said that the benefit from medical imaging, which is an accurate diagnosis, is greater than the small risk that comes with using it.

Discussion

1. **What is radiation?**

   a) A type of medicine

   b) Energy that moves as waves or particles

   c) Energy only from the sun

   d) Heat transfer between objects

   e) None of the above

   Correct Answer: b) Energy that moves as waves or particles

2. **Which of the following is NOT a source of everyday radiation exposure?**

   a) The sun

   b) Microwave ovens

   c) Car radios

   d) Swimming pools

   e) X-rays

   Correct Answer: d) Swimming pools

3. **How is the unit of absorbed dose defined?**

   a) Energy emitted by the source

   b) Energy absorbed per unit mass

   c) Total energy of radiation

   d) Energy stored in tissues

   e) Energy transferred as heat

   Correct Answer: b) Energy absorbed per unit mass

4. **What is the unit for absorbed dose?**

   a) Sievert (Sv)

   b) Gray (Gy)

   c) Millisievert (mSv)

   d) Rad

   e) Roentgen

   Correct Answer: b) Gray (Gy)

5. **What does whole-body absorbed dose mean?**

   a) Radiation absorbed equally across all organs

   b) Radiation absorbed only by the bones

   c) Radiation absorbed externally

   d) Radiation reflected by the skin

   e) Radiation absorbed over a lifetime

   Correct Answer: a) Radiation absorbed equally across all organs

6. **What factor is used to calculate the effective dose of radiation?**

   a) Tissue sensitivity

   b) Exposure time

   c) Frequency of radiation

   d) Skin color

   e) Weather conditions

   Correct Answer: a) Tissue sensitivity

7. **Which unit is commonly used for effective dose?**

   a) Gray (Gy)

   b) Millisievert (mSv)

   c) Roentgen

   d) Joule

   e) Watt

   Correct Answer: b) Millisievert (mSv)

8. **What does the equivalent dose account for?**

   a) Variation in biological damage by different radiation types

   b) The total energy absorbed in a specific organ

   c) Environmental factors

   d) Heat transfer in tissues

   e) Long-term aging effects

   Correct Answer: a) Variation in biological damage by different radiation types

9. **What is the primary risk associated with medical radiation?**

   a) Immediate burns

   b) Cancer development

   c) Genetic mutation

   d) Loss of eyesight

   e) Organ failure

   Correct Answer: b) Cancer development

10. **What principle is followed to minimize radiation exposure in medical imaging?**

    a) ALARA

    b) OSHA

    c) ARIMA

    d) BARA

    e) LEAN

    Correct Answer: a) ALARA

11. **What property allows X-rays to create images?**

    a) High temperature

    b) Ability to pass through tissues at different rates

    c) Reflective properties

    d) Emission of heat

    e) Magnetic field generation

    Correct Answer: b) Ability to pass through tissues at different rates

12. **Who is responsible for interpreting X-ray images?**

    a) General physician

    b) Radiologist

    c) Pathologist

    d) Cardiologist

    e) Oncologist

    Correct Answer: b) Radiologist

13. **How much radiation does a chest X-ray typically expose a person to?**

a) 0.01 mSv

b) 0.1 mSv

c) 1 mSv

d) 10 mSv

e) 100 mSv

Correct Answer: b) 0.1 mSv

14. **What is the approximate equivalent of a chest X-ray in terms of natural background radiation?**

a) 1 day

b) 10 days

c) 1 month

d) 6 months

e) 1 year

Correct Answer: b) 10 days

15. **Why is effective dose important in medical imaging?**

a) It measures total energy absorbed

b) It helps assess risk across the entire body

c) It calculates radiation efficiency

d) It eliminates all exposure risks

e) It directly cures disease

Correct Answer: b) It helps assess risk across the entire body

16. **What is the largest source of natural background radiation?**

a) Cosmic rays

b) Radon gas

c) Soil minerals

d) Medical imaging

e) Water contamination

Correct Answer: b) Radon gas

17. **How much effective dose does the average person in the U.S. receive yearly from natural sources?**

a) 0.3 mSv

b) 3 mSv

c) 30 mSv

d) 300 mSv

e) 0.03 mSv

Correct Answer: b) 3 mSv

18. **Which location typically has higher natural radiation exposure?**

a) Sea level

b) High altitudes (e.g., Colorado)

c) Underground caves

d) Tropical rainforests

e) Polar regions

Correct Answer: b) High altitudes (e.g., Colorado)

19. **What factor does NOT contribute to natural background radiation?**

a) Radon gas in homes

b) Cosmic rays

c) X-ray imaging

d) Soil composition

e) Altitude

Correct Answer: c) X-ray imaging

20. **Why do natural background doses vary?**

a) Individual skin color

b) Time spent indoors

c) Geographic and environmental factors

d) Age of the person

e) Use of electronic devices

Correct Answer: c) Geographic and environmental factors