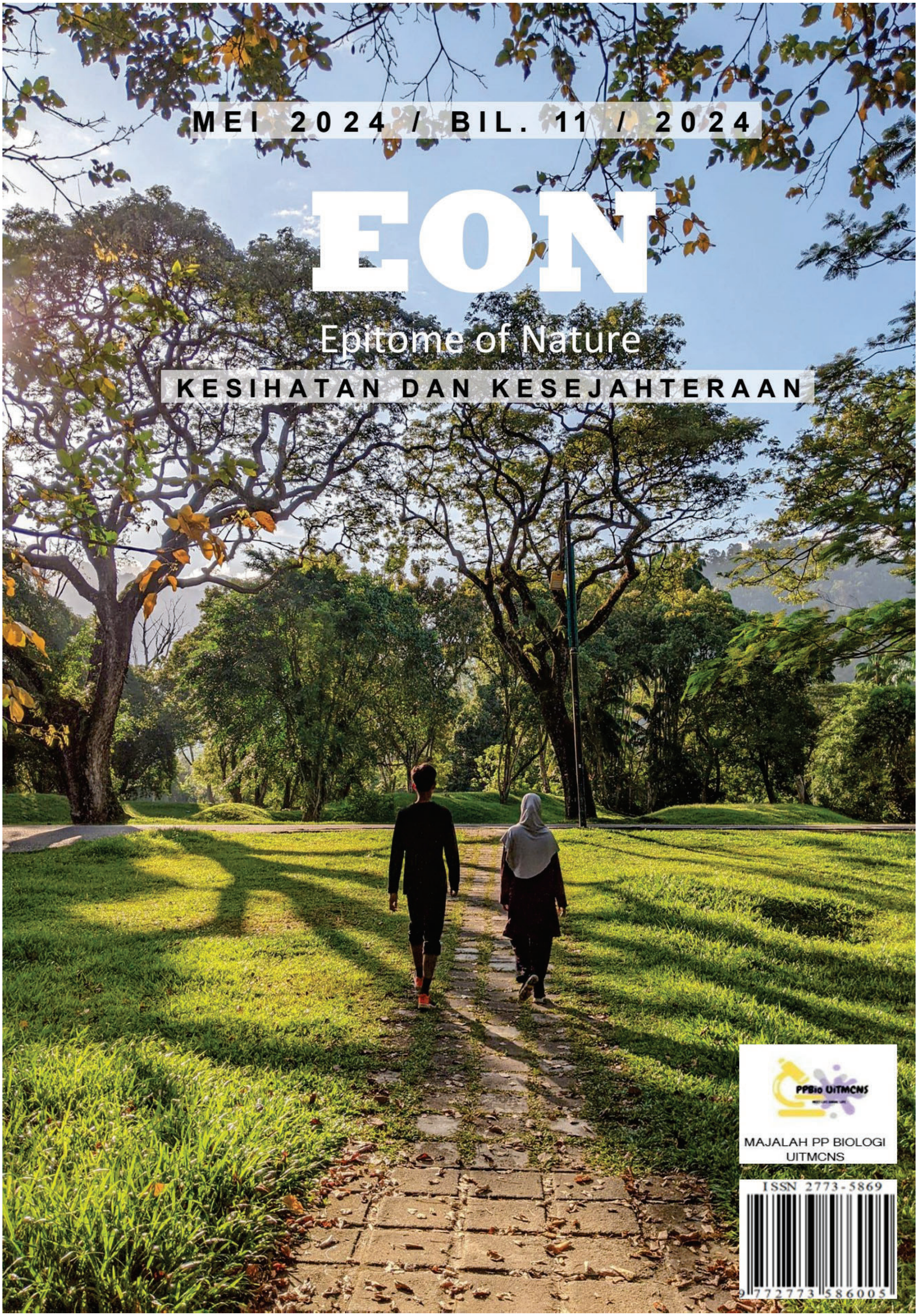
MEI 2024 / BIL. 11 / 2024

EON

Epitome of Nature

KESIHATAN DAN KESEJAHTERAAN



MAJALAH PP BIOLOGI UITMCNS

ISSN 2773-5869

CANCER RISK FROM MEDICAL RADIATION

Nurul Annisa Ramli[1], Nur Farhan Natasha Fadzil[1], Nursuhaila Muhamad Fauzi[1], Nur Azlin Atikah Mohd Nasir[1], Sharir Aizat Kamaruddin[1], Aimie Rifhan Hashim[1], Eliy Nazira Mat Nazir[2], Muhammad Nashiruddin Azizan[3].
[1]Fakulti Sains Gunaan, Universiti Teknologi MARA, Cawangan Perlis, Kampus Arau, 02600, Arau, Perlis, Malaysia.
[2]Fakulti Pengurusan dan Perniagaan, UiTM Cawangan Perlis, Kampus Arau, Arau, 02600 Arau, Perlis, Malaysia
[3]Kolej Undang-Undang Kerajaan dan Pengajian Antarabangsa, Universiti Utara Malaysia, 06010, UUM Sintok, Kedah Darul Aman, Malaysia

shariraizat@uitm.edu.my

EDITOR: DR. NURHAMIMAH ZAINAL ABIDIN

Every day people come into contact with radiation sources whether they are man-made or natural. Natural materials from within the earth and cosmic rays from space are sources of radiation. In contrast, man-made sources of radiation such as X-rays are often used for airport security scanners, medical imaging, cancer treatment and food irradiation. In the field of medicine, medical radiation is a type of radiation used to treat diseases or perform various diagnostic operations.

Every day people come into contact with radiation sources whether they are man-made or natural. Natural materials from within the earth and cosmic rays from space are sources of radiation

X-rays and gamma rays are electromagnetic radiation that have a high frequency and energy. In terms of physics, these two types of radiation have similarities such as being uncharged, having no mass and causing the same biological effects on the human body.

The ionization process of water atoms and molecules that occurs in the human body can result in biological cell changes and further increase the risk of cancer. The ionization process on water molecules causes hydroxyl radicals to form and the direct interaction of radiation with deoxyribonucleic acid (DNA) in the cell nucleus. This causes the effect of damage to DNA tissue cells or better known as the effect of biological radiation. Although this damage can be repaired immediately by the cell's repair system, it still increases the risk of cancer due to genetic changes in DNA.

The ionization process of water atoms and molecules that occurs in the human body can result in biological cell changes and further increase the risk of cancer.

These effects are generally considered to be stochastic effects which can occur even at low exposures and there is a possibility of increasing biological effects with the amount of exposure.

Simply put, ionizing radiation will cause cells to die or mutate. The damage experienced by the cell is dependent on the amount of ionizing energy received.

'ionizing radiation will cause cells to die or mutate'

Diagnostic imaging

If you think you have never been exposed to X-rays, you are wrong. At least once in our lifetime we will undergo a chest x-ray examination as a condition to enter the world of work or for the purpose of continuing education.

Figure 1 shows diagnostic imaging scanners in the Department of Radiology typically use a number of X-ray exposures. During the procedure, radiation exposure is usually determined according to the composition of the human body (weight, height, width) and also the type of examination.

In addition, the radiation exposure limit dose between scanners also differs from each other depending on diagnostic requirements. For an adult, the effective dose received during a chest X-ray examination is in the range of 0.01 - 0.03 mSv, while the effective dose from a chest examination using a CT scan machine is between 7.0 to 8.0 mSv.

For PET/CT scanners, the exposure dose received by the patient can reach up to 30 mSv. A skilled X-ray technician will ensure that the exposure factor used is according to the size and composition of the human body.

For example, the effective dose from an abdominal CT examination on an adult patient is in the range of 10 mSv. For a baby undergoing abdominal CT, if using the same exposure factor as an adult, he will receive twice the dose of an adult, which is 20 mSv. As a result, the risk of cancer for the child increases, following:

- Children's tissue cells are still in the process of growth and this makes them more sensitive to ionizing radiation than adults.
- The long-life expectancy of children causes the risk of cancer to increase in the future.

Figure 1: Diagnostic Imaging (Source: Health images, 2021)

Radiotherapy

Ionizing radiation can cause changes to cell structure. Changes in cell structure will disrupt cell functions as well as damage the cells. Figure 2 shows radiation therapy that uses high-energy waves or particles. Both cancer and normal cells in the treatment area exposed to radiation will go through these changes. Cancer cells that grow uncontrollably will receive severe damage and be destroyed while normal cells with regular growth are able to repair and restore cell function.

Side effects of radiotherapy can be divided into early and late effects. Side effects that occur during treatment are initial effects. It usually occurs 2 to 3 weeks after treatment begins. The examples of early effects of skin changes, nausea and mild diarrhea. It is an expected temporary effect. This effect may take 2 or 3 months to recover. In addition, during the radiotherapy procedure, high-dose X-rays produced through a linear accelerator (LINAC) are aimed directly at cancer cells with the aim of killing them. However, this process also causes an increase in the probability of cancer formation in other parts due to nearby healthy cells also undergoing mutations (changes). In general, the side effects are moderate if the amount of radiation dose to a particular cell and the volume of the tissue is small, the individual's health condition is good with a balanced nutritional intake, no smoking and drinking alcohol, and radiotherapy is carried out separately from chemotherapy. If side effects are severe, radiotherapy may be temporarily delayed.

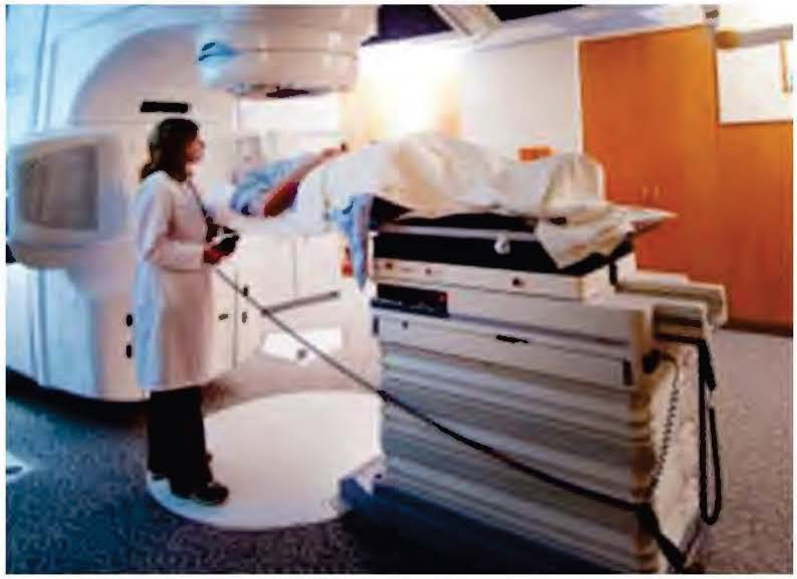


Figure 2: Radiation therapy uses high-energy waves or particles (Source: Dana-Farber Cancer Institute, 2016)

Reduces Cancer Risk

The risk from ionizing radiation still exists even if the amount of exposure used is low. In general, this risk cannot be completely avoided because the benefits are more than the harm. However, this risk can be optimized through legal control and proper technical management during the procedure. Exposure limits can be reduced through three methods:

I. Limit the number of X-ray examinations to the minimum possible. If reasonable, consider old radiographs for diagnostic evaluation.

II. Using alternative examinations that do not involve ionizing radiation such as MRI or Ultrasound.

III. Ensure optimal exposure output is used by setting parameters according to the patient's habits.

In conclusion, imaging procedures especially those involving sensitive organs such as the gonads and thyroid, are important to protect. Although the risk of cancer from exposure to diagnostic imaging radiation for individuals is small, this risk can increase if clinical benefit is not obtained. The patient's history and imaging records should be obtained first before repeat examinations are performed.

This is due to the fact that the original radiograph information can be used to make diagnostic decisions in addition to being able to reduce the amount of exposure to the patient. The amount of exposure received should also be recorded to consider future inspections.