International Commission on Radiological Protection

Task Group 111: Factors Governing the Individual Response of Humans to Ionising Radiation

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Introduction

Tissue reactions and stochastic effects after exposure to ionising radiation are variable between individuals. Factors and mechanisms governing individual responses to ionising radiation are complex and not well understood. These responses can be measured at different levels of biological organization following varying doses of radiation by analysing different endpoints such as cancers, non-cancer diseases and mortality in the whole organism; normal tissue reactions after exposures; and cellular endpoints such as chromosomal damage and molecular alterations. There are many factors that, to different degrees, influence the responses of individual people to radiation. In addition to the obvious factors of radiation quality, dose, dose rate and the tissue (sub)volume irradiated, determining factors include, among others, age and sex, life style (e.g. smoking, diet, and possibly body mass index), environmental factors, genetics and epigenetics, stochastic distribution of cellular events and systemic comorbidities such as diabetes or viral infections. Genetic factors are commonly thought to be a substantial contributor to individual response to radiation. The inheritance of an abnormally responsive phenotype among a population of healthy individuals does not follow a classical Mendelian, monogenic heredity pattern. Rather it is considered to be a multi-factorial, complex trait.

Publications

Members of the Task Group intend to publish papers addressing the topic of individual response to ionizing radiation during the development of the work, one manuscript is currently under review:

Applegate et al, Individual Response of Humans to Ionising Radiation – Governing Factors and Importance for Radiological Protection. Radiat. Environ. Biophys., under review

Scope

The Task Group will review the currently available information on individual radiation responses with special focus on the following questions and issues:

1. What is the impact of age, sex and other determinants on normal tissue reactions and incidence of cancers and other diseases following radiation exposure?

2. What is the contribution of genetics to individual, normal tissue responses with respect to adverse reactions to varying doses such as given during radiotherapy? Is it possible to predict a patient´s reaction to radiation exposure with the help of a predictive test or biomarker? How specific and sensitive are the tests which are currently proposed? Would such tests contribute to better radiation protection of radiotherapy patients without compromising cancer cure rates?

3. What is the contribution of genetic and epigenetic factors to tissue radiation response with respect to cancer induction at relevant doses and dose rates? How far does inherent spontaneous cancer susceptibility contribute to this? Does individual radiation response differ among cancer types? How does understanding of individual risk to radiation influence the transfer of risks between populations with different background cancer incidence?

4. What is the evidence that modifiable factors can affect individual risk of radiation-induced cancer, tissue reactions and other non-cancer diseases?

5. What are the ways to quantify the potential impact of individual response to radiation on the incidence of cancers, tissue reactions and other non-cancer diseases?