ICRP CONCEPTS AND TASKS IN INTERNAL DOSIMETRY

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INTRODUCTION

The uptake of a radionuclide and its retention with time in an organ or tissue (source organ or tissue) following its ingestion, inhalation, or systemic administration either by injection or through wounds, is described by biokinetic models, which are sufficiently simple to facilitate estimates of organ equivalent doses for radiation protection purposes. For the assessment of *annual limits for intake of radionuclides by workers* (ALI) and of *dose coefficients for intakes of radionuclides by members of the public* and *patients*, the International Commission on Radiological Protection (ICRP) has developed biokinetic models for the uptake of radionuclides by the gastrointestinal tract and the respiratory system, the latter for different ages. For the *systemic behaviour of radionuclides*, i. e. translocation of radionuclides to and between body organs and tissues, specific biokinetic models were adopted by the ICRP. Considering urinary excretion the ICRP has developed a kidney-bladder model to be applied to all substances used for kidney function tests, and to other radionuclides if urinary excretion results in a significant absorbed dose to the bladder wall.

The fraction of energy absorbed in a target organ or tissue from the transformations of a radionuclide in a source organ or tissue is mathematically described by a dosimetric model.

In the Symposium „Internal Dosimetry" the concepts of the ICRP for the assessment of doses to workers, members of the public and patients from radionuclides are described in detail by K. F. Eckerman and M. Roy considering biokinetic and dosimetric models and dosimetry of the respiratory tract, respectively. In addition application of ICRP concepts of internal dosimetry is presented by J. W. Stather for the special case of estimating the dose to the embryo and fetus following acute and chronic intakes of radionuclides by the mother.

The introductory paper describes present and future activities of the ICRP on internal dose assessments.

PRESENT AND FUTURE TASKS OF THE ICRP IN INTERNAL DOSIMETRY

The 1990 recommendations of the ICRP (1) are based on the most recent information from the epidemilogical studies in the populations of Hiroshima and Nagasaki. These recommendations indicate that the risk of radiation-induced cancer exceeds those assumed in the 1977 recommendations (2) by a factor of 3 to 4. Consequently, the primary dose limits for workers and members of the public were correspondingly reduced, i.e. from 50 mSv per year to 100 mSv during 5 years corresponding to an average of 20 mSv per year, and from 5 to 1 mSv per year, respectively. Consequently the devired or secondary limits, i.e. the ALI and the Derived Air Concentration DAC have to be adapted.

Since Committee 2 of the ICRP is responsible for the development of values of secondary limits and thus for the assessment of those data underlying these limits the major future tasks of the Committee is to adjust internal dose calculations to the new recommandations of the ICRP (1) considering organ/tissue and radiation weighting factors, and taking into account recent knowledge on biokinetic behaviour of radionuclides.

DOSES TO MEMBERS OF THE PUBLIC

As an extension of its work for many years in the field of developing secondary limits for the control of intakes of radionuclides by workers, in March 1987 the ICRP established a Task Group of Committee 2 charged with the assessment of internal dose coefficients as a function of the individual's age. The work of the Task Group has been limited to a consideration of those radioisotopes of elements which are expected to be released into the environment due to human activities, and which may have significance for environmental radiation protection purposes.

Age-dependent ingestion dose coefficients for radioisotopes of 29 elements together with preliminary inhalation dose coefficients for radioisotopes of 11 elements, based on the ICRP 30 lung model and the ICRP 26 tissue weighting factors, were published in Publications 56, 67 and 69 (3, 4, 5). Age-dependent inhalation dose coefficients for radioisotopes of the above 29 elements together with those of curium and calcium were calculated by means of the Human Respiratory Tract Model for Radiological Protection (to be described by M. Roy in this symposium) in ICRP Publication 66 (6) for a median aerodynamic diameter of 1 μm and were published in ICRP Publication 71 (7). Compounds, previously assigned to lung clearance Classes D, W, and Y in Publication 30 (8, 9, 10), have been allocated to lung absorption types F, M and S, with f_1 values for material cleared to the GI tract taken from ICRP publications 56, 67 and 69 (3, 4, 5). If additional information on GI absorption was available, then this was applied and detailed in the datasheets.

In addition, Committee 2 is developing a report on doses to the embryo and fetus following acute or chronic intakes by the mother of radioisotopes of the above 29 elements plus curium and calcium (to be described by J. W. Stather in this symposium).

A further activity of Committee 2 is to estimate the reliability of ICRP's dose coefficients for intakes of radionuclides by ingestion and inhalation. The main aim is to develop an approach which should be quantitative, selective, addressing only health individuals of various ages and a limited number of elements. Reliability refers to

- the GI tract model,
- f_1 values for gastrointestinal absorption,
- the respiratory tract model,
- systemic biokinetic models.

In addition, uncertainty concerns the biokinetics of radioactive progeny produced in the body. Variability of doses will be considered quantitatively for specified examples of elements.

DOSES TO WORKERS

The terms of reference of the Task Group of Committee 2 on Internal Dosimetry was extended in 1993 to include a revision of ICRP Publications 30 (8, 9, 10) on Limits for Intakes of Radionuclides by Workers ALI. In order to permit immediate application of the Commission's 1990 Recommendations (1), revised values of the ALI based on the methodology and biokinetic information from ICRP Publication 30, but which incorporated the new dose limits and radiation and tissue weighting factors, were calculated by the Task Group on Dose Calulations and issued as ICRP Publication 61 in 1991 (11).

Since issuing this Publication, ICRP has published the revised kinetic and dosimetric model of the respiratory tract in Publication 66 (6). To give values of inhalation dose coefficients for workers using this new model, both Task Groups an Internal Dosimetry and Dose Calculations of Committee 2 have recalculated the dose coefficients for workers underlying the ALI in

Publication 61 (11). These revised dose coefficients were published as ICRP Publication 68 (12).

In due time, possibly in about 5 years, a complete revision of ICRP Publication 30 (8, 9, 10) will be issued, taking into account new anatomical and physiological data, and newer biokinetic models. It is intended to publish inhalation and ingestion dose coefficients for radioisotopes of elements being relevant for work places, together with bioassay data for monitoring purposes.
The comprehensive revision of Publication 30 will include:

- a review of the choice of lung absorption parameters and default absorption types for inhalation of different chemical forms of the elements found in the workplace;
- a consideration of data on f_1 values for ingested or swallowed chemical forms after inhalation;
- an update of the biokinetic data and models for systemic activity for the elements not covered in Publications 56, 67, 69, and 71 (3, 4, 5, 7);
- provision of models that can be used both for internal dosimetry and for interpretation of bioassay data.

An interim revision of ICRP Publication 54 (13) on „Individual Monitoring for Intakes of Radionuclides by Workers: Design and Interpretation" is inteded to be published early in 1997 to provide data for monitoring that are consistent with ICRP Publication 68 (12). The report will cover selected radioisotopes of the following elements: ^{3}H, Fe, Sr, Ru, I, Cs, Ra, Th, U, Pu, Am, Cu, and Cf. Tabular data will be provided for the excretion over the first 7 days post intake. Equilibrium levels will be given only for long-lived radionuclides.

The Task Group on Dose Calculations is giving consideration to changes in dosimetric models before the revision of Publication 30 (7, 8, 9) can be issued. These include:

- modifications to absorbed fractions of α and β/γ emitters deposited in the skeleton;
- need to allow for bremsstrahlung in the calculation of the Specific Effective Energy;
- use of phantoms based on medical imaging data for dosimetric modelling;
- taking account of the distribution of blood in different organs and tissues;
- consideration of new Reference Man data for the distribution of red bone marrow;
- consideration of females;
- depth doses in walled organs, e.g. the urinary bladder;
- the possibility of a revised model for the GI tract.

For dosimetric purposes parts of Publication 23 (14) on Reference Man will be revised. The report on skeleton was published recently as Publication (15).

The report on anatomical data and gross body composition is under preparation. Further reports will be on

- elemental composition,
- physiological data, and
- gastrointestinal tract.

DOSES TO PATIENTS

In 1988 a Task Group of ICRP Commitee 2 has published a report as Publication 53 (16) on Absorbed Doses to Patients from Radiopharmaceuticals to give absorbed and effective

doses for 113 radiopharmaceuticals labelled with 74 radioisotopes of 36 elements, including the range of variation to be expected in pathological states, for adults, children, infants and the fetus. This data is continuously updated by a Task Group of Committees 2 and 3 and published as addenda to the Annals of the ICRP (17), and can be used also as a measure for the dose from occupational exposure of personal engaged in the manufacture or use of radiopharmaceuticals.

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