4th International MELODI Workshop

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Break-out session 2C: Low dose dosimetry and dose concept

Thursday, 13 September at 16-18 hours

Moderator: Hans Rabus, PTB

Rapporteur: Eric Blanchardon, IRSN

Outline of this session

- Short intro by moderator
- Three blocks consisting of
  1. Presentations of 1-2 posters (3-5 min‘s)
  2. Presentation of the item on the agenda
  3. Discussion
  4. Electronic poll on 1-3 questions

Posters: dosimetric methods

- Grainne Manning et al. 'Transcriptional dose-responses of radiation biomarkers in human and mouse blood samples ex vivo'

Observation of a linear dose response in the transcription of nine genes of interest, 2 to 24 hr after low dose (5 – 100 mGy) irradiation of human (and mouse) blood. These genes therefore appear as good exposure biomarkers, despite evident variability between donors.

Posters: dosimetric methods

- Ausrele Kesminiene et al. ‘A novel approach for assessing organ doses from paediatric CT scans in EPI-CT’

Assessment of organ doses in the epidemiological study of risk from paediatric CT scans. Two approaches, before (from paper files and questionnaires) and after (from DICOM headers) picture archiving computerized system, are applied to a cohort of about a million. Monte-Carlo simulation of irradiation with computational phantoms and probabilistic uncertainty analysis are planned.

Discussion Topic 1

Are the current dosimetric methods suitable to investigate the shape of the dose response curves for the risk of cancer and non cancer diseases?

Discussion 1

There is no unique relation between exposure, dose and response. ICRU publication 86 suggests that absorbed dose is a deficient parameter in some situations (heterogeneous irradiation).

How the different parameters of radiation exposure affect the outcome should be investigated and the knowledge cast into a single quantity associated with complementary information.

Consideration of microdosimetry and dose rate at the level of the cell would be relevant.

1. Which of the following fields of dosimetric measurement need improvement of tools and methods and should be given priority in order to advance low-dose research?

1. Low-dose external dosimetry of low-energy X rays 8,5%
2. External dosimetry of neutrons and ions 14,9%
3. Internal dosimetry 23,4%
4. biological dosimetry 10,6%
5. microdosimetry / nanodosimetry 21,3%
6. track structure imaging 12,8%
7. detection of reactive species 2,1%
8. other 0,0%
9. I don't know, I am not an expert on this question 6,4%
10. I don't think that further developing dosimetric measurement should be given priority. 0,0%

48 sekuntia jäljellä.

2. Which of the following fields of research and development should be given high priority?

1. identification of the radiosensitive target 30,4%
2. quantification of uncertainty 23,9%
3. radiation quality 28,3%
4. co-action of chemical toxicity and radiotoxicity of internal emitters 10,9%
5. specific properties of radioactive nanoparticles 6,5%
6. Other aspects 0,0%
7. I don't know, I am not an expert on this question 0,0%
8. I don't think that modelling of radiation tracks and specific biological impacts should be given priority. 0,0%

44 sekuntia jäljellä.

Poster: internal emitters

- Fabrice Petitot et al. ‘Inhalation of uranium nanoparticles: deposition in respiratory tract and translocation to secondary target organs in rats’

The study of deposition and clearance of nanoparticles (CMD 38 nm) of uranium dioxide inhaled by rats shows 27% deposition efficiency, 1/5 rapid clearance to systemic circulation, 4/5 slow clearance (>24 h). Further long-term study for toxicity (inflammatory effect) of retained nanoparticles.

Discussion Topic 2

Can the information on dosimetry and biokinetics of internal emitters be improved to understand radiation-induced biological short and long term effects of radionuclides?

Discussion 2

The chemical toxicity of uranium is well documented but this is not true of shorter lived radionuclides.

The possible synergy of radiation and chemical toxicity of incorporated radionuclides is an issue which requires further studies. Biokinetic data are relevant for both toxicity but ways to quantify interaction have to be investigated.

Inhaled nanoparticles raise specific issues of the same nature.

4. Are there classes of radionuclides that should be prioritised (when scoping internal emitter studies) to gain an understanding of their effects as regards cancer and other late appearing pathologies?

1. Alpha emitters	32,6%
2. Beta emitters	11,6%
3. Auger emitters	18,6%
4. actinides	11,6%
5. other fission and activation products	4,7%
6. naturally occurring radionuclides in general	4,7%
7. radiopharmaceuticals	7,0%
8. other	0,0%
9. I don't know, I am not an expert on this question	9,3%
10. I don't think that radionuclides should be given priority.	0,0%

48 sekuntia jäljellä.

5. Are there specific radionuclides that should be prioritised (when scoping internal emitter studies) to gain an understanding of their effects as regards cancer and other late appearing pathologies?

1. Caesium 10,6%
2. Iodine 10,6%
3. Radon 34,0%
4. Thoron 6,4%
5. Tritium 21,3%
6. other 10,6%
7. I don't know, I am not an expert on this question 4,3%
8. I don't think there are radionuclides that should be given priority. 2,1%

47 sekuntia jäljellä.

Posters: modelling

- Nora Hocine et al. ‘Cellular dosimetry of Sr-90 using Monte Carlo code MCNPX’

The calculation with MCNPX of cellular S-values (nuclear dose rate per unit activity) for Sr-90 in nucleus or in cytoplasm is in good agreement with reference MIRD publication.

Posters: modelling

- Paola Fattibene et al. ‘How can the EURADOS network on “Retrospective Dosimetry” contribute to research at low doses?’

EURADOS is a network of more than 50 European institutions promoting research, training and harmonization in ionizing radiation dosimetry. Its WG10 develops a multidisciplinary (biology and physics) approach to retrospective dosimetry of interest for MELODI, with a focus on uncertainty, biodosimetry of internal emitters, training and emergency preparedness.

Discussion Topic 3

Is modelling of radiation tracks and specific biological impacts the way forward to a harmonized dosimetric approach?

Discussion 3

While the value of new experimental input into modeling is acknowledged, experimental validation of track history appears difficult.

Multiscale simulation accounting for variability in time and space should be performed.

Collaborative projects such as EU ‘Biologically weighted quantities in radiotherapy’ (BioQuaRT) and publicly available codes like GEANT4 will help.

6. In the field modelling of radiation tracks and specific biological impacts of low doses, the following aspects should be given priority

1. The relevant basic physical data (interaction cross sections, fragmentation probabilities of biomolecules, ...) 14,9%
2. The relevant basic chemical data (reactive species production rates and their lifetimes, diffusion coefficients, ...) 6,4%
3. The relevant basic biological data (repair kinetics, biokinetics, ...) 31,9%
4. Track structure simulation techniques 12,8%
5. Experimental techniques for radiation quality and track structure characteristics 12,8%
6. Tools and models for the biochemical stage 6,4%
7. Tools and models for the biological impacts 12,8%
8. Other aspects 0,0%
9. I don't know, I am not an expert on this question 2,1%
10. I don't think that modelling of radiation tracks and specific biological impacts should be given priority. 0,0%