

Biological effects resulting from an internal contamination with low dose of radionuclides (cancer and non-cancer effects)

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Examples of exposure situations

- Radon exposure
- Drinking water
- Nuclear Power Plants
- Chernobyl accident
- Techa River
- Mayak workers
- Weapon testing fallout
- Factories producing uranium
- Uranium mines
- Medical uses

Occupational exposure

Public exposure

Patients exposure

Radionuclides

- **Plutonium:** lung cancers in Mayak workers
- **Strontium:** different decays depending on the radioisotopes
- **Radium:** new study on luminisers?
- **Radon:** interaction with smoking, model for lung cancer induction, better dose estimation available?
- **Tritium:** high energy deposited in small volume
- **Uranium:** route of exposure, cellular localization, depleted/enriched uranium

Exposure or dose

- Calculation of dose:
 - Uncertainties in estimation of the dose
 - Especially for epidemiological studies
 - Definition of the dose to taken into consideration: absorbed dose, effective dose, ...
- To establish model for dosimetric evaluation
 - Factors to consider:
 - Pathway administration
 - Low dose rate and low dose
 - Chronic exposure
 - Radiation quality
 - Biokinetics

Epidemiological studies

- Cohorts; sample size
- Individual exposure data needed
- Information on outcome/disease
- Information on confounders, ...
- Careful with interpretation of ecological studies
- Dose-response at very low doses difficult to interpret
- Utilization of existing biobanks and cohorts
- Interaction with experimental studies
- Interaction with dosimetry

→ Road map for epidemiological studies

Mechanisms

- Are there different mechanisms for low and high doses?
 - Are there different mechanisms between chronic and acute exposure?
 - How to dissociate mechanisms leading to cancer and to non-cancer effects?
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- Localization of radionuclides: binding of radionuclides (uranium) to DNA
 - Genomic instability
 - Mutations
 - Phenotype changes
 - DNA repair
 - Shapes of dose-response curves (biphasic)

Biomarkers

- Genotoxic markers
- Proteins (proteomic analysis)
- Immunological markers
- Epigenetics
- Gene expression

→ Markers of exposure / effect ?

Other issues

- Adaptation to background radiation ?
- Risk perception and communication

In conclusion

- Need for proper dosimetry
- Well-designed and completed epidemiological studies
- Strong collaboration between epidemiologists, biologists, dosimetrists
- To perform studies on uranium effects

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