

# IAEA-activities related to Radiation Biology and Health Effects of Radiation

International Expert Symposium in  
Fukushima

- Radiation and Health effects –  
September 11-13, 2011, Fukushima, Japan

# IAEA research activities related to (accidental) radiation exposures:

- Capacity building in MSs & stimulate networking among radiobiology laboratories/institutes in regions,
- Technical Meetings / Consultants Meetings on Radiation and Health topics (*low-high dose exposures; early / late effects*), biodosimetry (*cytogenetic assays*),
- Research: initiation of projects (*Coordinated Research Projects*) and international collaboration (*collaborative centres and agreements with “established” institutes*),
- Training and instruction: development of materials /courses, education programs, syllabi & publications,

# Capacity building & networking related to Radiation Biology in MSs:

## **TC-national and regional projects (MS-driven):**

- **SRL6031**; Establishing laboratory facilities for Biological Dosimetry; 3-4 year project (*equipment, fellowships etc.*),
- **ALG7004**; Developing National Capacities in Radiation Biology; 3-4 year project (*equipment, fellowships etc.*),
- **Expert missions to MSs** (*on request*).

## **Co-ordinated Research Projects (division level):**

- Human Health (*NAHU*); Applied Radiation Biology and Radiotherapy section (*ARBR*).

# NAHU research projects on Radiation Biology and Health effects of Radiation

- Stem cell therapeutics to modify radiation-induced normal tissue damage (*E33032*),
- Strengthening biological dosimetry in IAEA-member states (*1833*).

# Stem Cell Therapy to modify Radiation-induced NT-damage

## **Aim:**

- Improved outcomes in Radiotherapy
- Design new strategies in the treatment of victims of radiation accidents

## **Action plan (activities):**

- Participation of 12 institutes (*10 MSs*);
- Each centre focuses on at least one specific stem cell technique and one specific experimental organ/tissue (*skin, lung, heart, salivary/lacrimal gland etc.*)
- **Project period: 2008-2012; 3 RCMs, 8 RC, 4 RA**

# Stem Cell Therapy to modify Radiation-induced NT-damage

## Expected Research Outcomes:

- Improved knowledge on Stem Cell Therapy in MSs,
- Modification of normal tissue / organ damage,
- Improving outcomes in Radiotherapy (*long term*),
- Provide technical expertise in the treatment of (*accidental*) radiation injuries,
- Collaboration between relevant laboratories, establishment of exchange programs and joint applications for additional funding.

# Stem Cell Therapy to modify Radiation-induced NT-damage

## Treatment of skin injuries (radiation ulcers):

- Skin defect model: Mesenchymal Stem Cells (*MSC*) associated with Fibroblast growth factor; **(FRA)**,
- Regenerating template model: Engineered skin substitute (Chitosan) enriched with HFSC; **(MAL)**,
- Bioengineered skin: keratinocytes layers; **(IND)**
- Amnion dressings (fresh/lyophilized; +/- enriched with skin cells); **(IND)**,
- Recombinant growth factors (*EGF production*) in combination with stem cell therapy; **(BRA)**.

**In vitro/in vivo research; animal models / clinic.**

# Strengthening Biodosimetry in MSs

## **Biodosimetry:**

Biological dosimetry is a tool/ technique (*cytogenetic assay*) to measure or estimate the dose of ionizing radiation energy absorbed by an individual using its own blood lymphocytes.



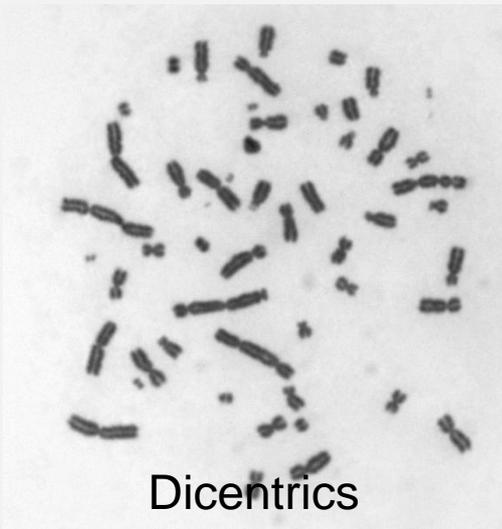
## **How do these assays work?**

When the energy associated with ionizing radiation is transferred to atoms and molecules in cells, the chromosomal DNA is damaged (*SSBs and DSBs*) in proportion to the type and amount of energy that is absorbed.

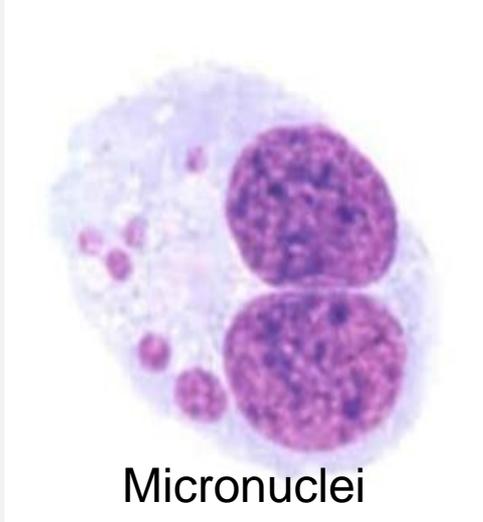
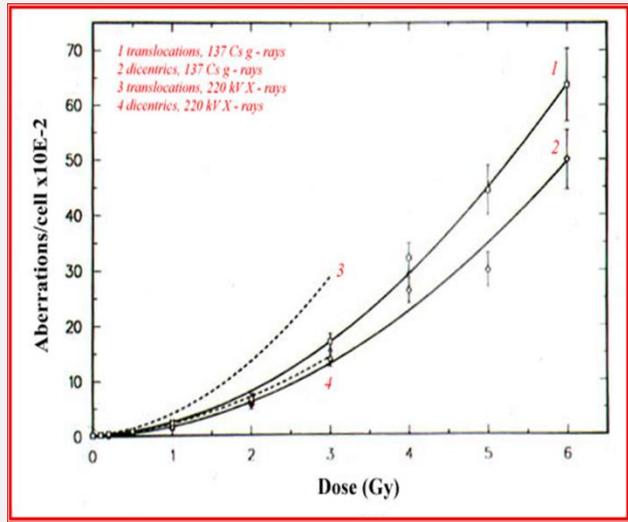
# Strengthening Biodosimetry in MSs

## Induction of chromosomal damage:

Chromosomal abnormalities (as a result of DSBs), such as dicentrics, can be induced by a radiation exposure. The number of dicentrics is quantified and compared to a known calibration curve in order to derive a dose estimate.



Dicentrics



Micronuclei

# Strengthening Biodosimetry in MSs

## Why is biodosimetry needed:

Most victims (*general public*) of radiation/nuclear casualties don't wear personal dosimeters (*especially outside location*) or victims do not show acute clinical signs yet.

## Biodosimetry helps to:

- Facilitate short term triage (*decision making*),
- Predict the time course and severity of the phases of ARS (*Acute Radiation Syndrome*),
- Suggest countermeasure that will be needed to treat ARS, especially acutely,
- Assess the health risk (*long term consequences*) from radiation exposure.

# Strengthening Biodosimetry in MSs

## Major Aim:

To increase the preparedness of biological dosimetry laboratories/institutes in IAEA-MSs to react on radiation/nuclear accidents nationally, and in the region.

- To set up suitable standards to monitor individuals exposed to radiation,
- To update existing technology related to biological dosimetry,
- Introduce “state of the art” technology,
- Initiate national-, regional- and international-networks on biological dosimetry.

# Strengthening Biodosimetry in MSs

## Action plan (activities):

- Participation of 10-14 laboratories; each participating centre will focus on standard cytogenetic assays,
- Harmonization of cytogenetic assays (*dicentrics, micronuclei, and PCC and if feasible also FISH*),
- Establishment of background frequencies for chromosomal aberrations,
- Inter-comparison studies (*generation calibration curves*),
- Initiation of national, regional-, international networks, which can be applicable in scenarios of mass casualties.
- **Project period: 2012-2016; 3 RCMs, 10 RC, 4 RA**

# Strengthening Biodosimetry in MSs

## Expected Research Outcomes:

- Increased preparedness of participating laboratories / institutes to radiation / nuclear accidents,
- Improved knowledge and technical expertise in radiation biology and biological dosimetry (“agreed protocols”),
- Monitoring of exposed individuals for human risk assessment,
- Collaboration between relevant laboratories (*establishment of an active network*).

# Training course: Medical Response to a Radiological Emergency

Training Course for Medical Response to a Radiological Emergency

Day1	Day2	Day3	Day4	Day5
9:30 - 10:00 Registration	9:00 - 10:00 Basics of Biological Effects of Ionizing Radiations Part2	9:00 - 10:00 Medical Response to a Radiological Mass Casualty Event	Lessons Learned from Past Radiation Emergencies 9:00 - 9:40 - NPP accident : Chernobyl	9:00 - 10:00 Review-test and Assessment
10:00 - 10:20 Formal opening and workshop administration	10:00 - 11:00 Acute Radiation Syndrome	10:00 - 11:00 Psychosocial Aspects in Radiological Emergencies	9:40 - 10:20 - Exposure and Contamination Accident : Goiânia	10:00 - 11:30 Evaluation of the workshop
10:20 - 10:40 Pre-test			10:20 - 11:00 Criticality accident : Tokaimura	11:30 - 12:00 Closing
<i>Coffee Break</i>	<i>Coffee Break</i>	<i>Coffee Break</i>		
11:00 - 12:00 Radiation Accidents: Scope of The Problem, Statistics	11:30 - 12:30 The Cutaneous Radiation Syndrome (Local Radiation Injuries)	11:30 - 12:30 Terrorism into perspective	11:00 - 11:40 -Gammagraphy accident : Peru & Chile	
<i>Lunch Break</i>	<i>Lunch Break</i>	<i>Lunch Break</i>		
13:00 - 14:00 Basic Concepts of Ionizing Radiations	13:30 - 14:30 External and Internal Radioactive Contamination	13:30 - 14:30 Providing Information for Medical Community and The Public	11:40 - 12:20 -Hospital accident : Indiana-Pennsylvania	
14:00 - 15:00 Principles of Radiation Protection and Detection	14:30 - 15:30 Medical Management On-site and at Pre-hospital Levels	14:30 - 15:30 Cytogenetic Dose Assessments	<i>Lunch Break</i>	
<i>Coffee Break</i>	<i>Coffee Break</i>	<i>Coffee Break</i>	13:30 - 14:30 Demonstration : PPEs	
15:30 - 16:30 Basics of Biological Effects of Ionizing Radiations Part1	16:00 - 17:00 Hospital Preparedness and Management of persons accidental exposed	16:00 - 17:00 Handling Deceased Bodies Contaminated with Radioactive Materials	15:00 - 17:00 Tabletop Exercise	

# Training course: Medical Response to a Radiological Emergency

## **44 LECTURES: 40-60 min**

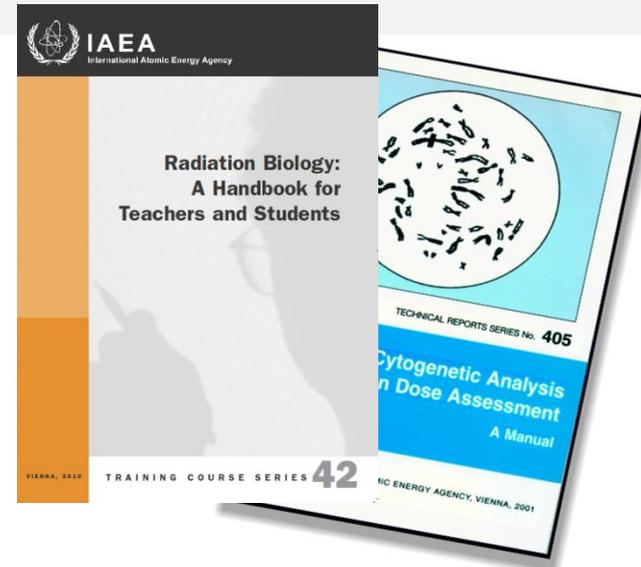
- BASIC (22): Radiation Accidents; Scope of the Problems and Statistics, External and Internal Radioactive Contamination, Radiation, Psycho-social aspects in Radiological Emergencies,
- ADVANCED (7): Medical response to a Radiological Mass Casualty Event, Planning and Preparedness of the Medical Response, Handling of Deceased Bodies Contaminated with Radioactive Materials
- LESSONS LEARNED (15): Radiation Accidents, Goiana, Chernobyl, Tokai-mura,

# Training/Education/Publications:

- **Training material on:** Radiation Biology (*in general*), (*PPTs, e-learning material, Human Health Campus website*):

<http://humanhealth.iaea.org>

Biological dosimetry



- ***In preparation:*** Organisation of Workshops and Symposia: in the Asia & Pacific region (*in collaboration with NIRS-Chiba and HICARE-Hiroshima*) related to Radiation Biology, Biological Dosimetry and Health effects of Radiation (*incl. nuclear accidents*).

# Concluding remarks:

## The recent accident with the Fukushima NPP stresses the need to:

- Improve education/information on Health effects of Radiation; by raising awareness to the general public, and by educating the professionals on “Preparedness to accidents”,
- Biological dosimetry is an essential tool for timely determination of the radiation dose to the exposed individuals (*i.e. exposed workers and general public*) - update existing technology and/or apply “state of the art” technology, initiate national, regional and international networks,
- Initiate research to develop new strategies to treat victims of radiation accidents.

