Preparedness for Radiological Emergencies in Thailand

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Preparedness for radiological emergencies in Thailand

- Radiological accident in Thailand
- Research activities
- Training
- Networking of Biodosimetry in Thailand
- Establishment of National Biodosimetry Laboratory
Radiological accident in Thailand

- A serious radiological accident occurred in Thailand in 2000
- The Siemens Gammatron-๓ teletherapy unit with 425 Ci of $^{60}$Co
- Several individuals obtained access to the unsecured storage location and partially disassembled a teletherapy head.
Radiological impact of the accident

- Ten people received high doses from the source.
- Three of those people, all workers at the junkyard, died within two months of the accident as a consequence of their exposure.
- Despite the absence of metaphases in cultured lymphocytes from most of the blood or marrow samples, severe chromosomal aberrations could have been detected (multiple rings, dicentrics).
Chromosomal Study

Dicentric and centric ring chromosomes in the karyotype of P10 four weeks after exposure.

Triple ring chromosomes in the karyotype of P2 six weeks after exposure.
The IAEA’s report

- There was apparently no adequate biological dosimetry to assess the probable range of the radiation doses received by the individuals involved.

“A cytogenetic laboratory needs to be designated as the (national) biodosimetry laboratory in a State in which radiation sources capable of causing severe radiation accidents are widely used. This laboratory needs to develop its own calibration curves for the most common types of acute radiation overexposure, for example due to $^{60}$Co, $^{192}$Ir and $^{137}$Cs”.

IAEA report, 2002
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Previous research projects

- Project title “Biological monitoring of chromosomal damage in subjects occupationally exposed to low levels of ionizing radiation using micronucleus assay” during 2006-2008.

- Project title “Relationship between DNA damage and acute exposure to gamma and x-rays” funded by Ministry of Science and Technology during 2010-2011.
Present research project

- Research Contract No. 17073/THA
- Project Title “Radiation Biodosimetry: Preparedness for Radiological Emergency in Thailand”
Main objective

- to apply different types of cytogenetic assays to perform biological dosimetry for radiation emergency preparedness in our country
Specific objectives

- To initiate a national biological dosimetry network among
  - an authorizing institute: Office of Atoms for Peace (OAP)
  - other research institutes/laboratories having expertise on applying different types of cytogenetic assays for biological dosimetry
    - Kasestsart University
    - Ramathibodi Hospital
    - Ministry of Public Health

- To establish technical competence in biodosimetry through national and international collaborations
Detailed Workplan (1st year)

- Mapping of dose-rate distribution from a $^{60}$Co teletherapy unit
  - at the Secondary Standard Dosimetry Laboratory (SSDL), Ministry of Public Health.
  - to find the suitable geometry and minimize the corrections for distance, absorption and scattering at the blood/holder interface.
- Preferred dose-rate: 0.6-1.0 Gy/min
Detailed Workplan (1st year)

- Study the effect of some important factors on yields of dicentrics and PCC-rings.
  - Sex
  - Smoking
- Blood samples will be drawn from 3 subjects for each group.
- Irradiation for 3 Gy at a dose-rate of 0.6-1.0 Gy/min.
- Determination of background frequency of dicentrics and PCC-rings by using the same samples from previous step but without irradiation.
- Establishment of dose-response calibration curves for $^{60}$Co with dicentric and PCC assays using IAEA guidelines.
## Establishment of dose response curves

<table>
<thead>
<tr>
<th>Dose (Gy)</th>
<th>Dicentric WB</th>
<th>Dicentric IL</th>
<th>PCC WB</th>
<th>PCC IL</th>
</tr>
</thead>
<tbody>
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<td>0</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
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<td>0.1</td>
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<td>0.25</td>
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<td>0.75</td>
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<tr>
<td>25</td>
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<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Results

A $^{60}$Co teletherapy unit
The exposure set up calibrated by a cylindrical ionization chamber (red arrow)
The dose-rate distribution

<table>
<thead>
<tr>
<th>Distance from source (cm)</th>
<th>Dose rate (Gy/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>1.72706</td>
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<tr>
<td>70</td>
<td>1.28460</td>
</tr>
<tr>
<td>85</td>
<td>0.85241</td>
</tr>
</tbody>
</table>
Preliminary Results

- PCC-ring frequency

PCC-ring chromosomes in M/A phase are easily analyzed comparing to G2/M phase as chromatids are well separate.
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Trainings for cytogenetic techniques (1)

- Organizing the national workshops trained by a cytogenetic expert, Prof. Dr. Kanokporn Noy Ridthidech, from Stony Brook University (2002, 2006)
  - 2002: Biomarkers of Exposure to Low Doses of Ionizing Radiation
  - 2006: Biological Dosimetry of Exposure to Environmental Carcinogens: Ionizing Radiation as a Model
Trainings for cytogenetic techniques (2)

- Dispatching the expert under the MEXT Nuclear Researcher Exchange Programme 2010, 2011 and 2012
  - Prof. Dr. Mitsuaki Yoshida, Hirosaki University
Training Meeting on Biodosimetry in the 21st Century
Training for cytogenetic technique **under TC project**

- An OAP staff has been accepted to be intensively trained for 3 months at Hirosaki University granted by the IAEA
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Brain-storm Meeting at Ramathibodi Hospital on Sep 14, 2012 (1)

- Establishment of working group or steering committee
  - Department of Applied Radiation and Isotopes, Faculty of Science, Kasetsart University
  - Thailand Institute of Nuclear Technology (Public Organization) (TINT)
  - Bureau of Technical Support for Safety Regulation, Office of Atoms for Peace (OAP)
  - Department of Disease Control, Ministry of Public Health
  - Human Genetics Unit, Department of Pathology, Faculty of Medicine Ramathibodi Hospital, Mahidol University

- Human Genetics Unit is willing to be the main cytogenetic biodosimetry lab
Brain-storm Meeting at Ramathibodi Hospital on Sep 14, 2012 (2)

- Selection of the main institute to take care all network members
  - All participants agreed that OAP was appropriate to be the main institute and play roles in the network
- Pick up cytogenetic labs from the whole country
  - The clinical cytogenetic labs who are members of Human Cytogenetics Consortium of Thailand were selected and invited to attend the kick-off meeting
- The kick-off meeting was on January 4, 2013
- Establishment of Cytogenetic Biodosimetry Network of Thailand
Kick-off Meeting on Biodosimetry Networking (on January 4, 2013)

Five institutes participated

- Ramathibodi Hospital
- Kasetsart University
- Office of Atoms for Peace (OAP)
- Thailand Institute of Nuclear Technology (Public Organization) (TINT)
- Konkhaen University who is a member of Human Cytogenetics Consortium of Thailand
Training Meeting on Biodosimetry in the 21st Century

June 10-14, 2013
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Establishment of National Biodosimetry Laboratory

- The Government accepted the request of OAP to set up the National Ionizing Radiation Metrology Project.
- The National Biodosimetry Laboratory was included as one of seven laboratories within the National Ionizing Radiation Metrology Project.
- OAP has already been allocated the budget from the government in the fiscal year 2014 (starting from Oct 2013) to provide the equipment and materials for cytogenetic facilities.
Perspectives of the National Ionizing Radiation Metrology Building (1)
Perspectives of the National Ionizing Radiation Metrology Building (2)
Timeline of Biodosimetry in Thailand

- 2000: Workshop
- 2002: Workshop
- 2004: Workshop
- 2006: Research on low-dose radiation effect
- 2008: Training by Dr. M. Yoshida
- 2010: Setting up of National Biodose Lab
- 2012: 
- 2014: 
- 2016: 

June 10-14, 2013 Training Meeting on Biodosimetry in the 21st Century

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- MEXT Nuclear Researcher Exchange Programme
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- Ms. Banchawan Rungsimaporn, Ramathibodi Hospital
- Mr. Supol Khanchong, OAP
Thank you