

Report

Report on the 1st Educational Symposium on RADIATION AND HEALTH by Young Scientists (ESRAH2014)

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On March 11, 2011, the Fukushima Daiichi Nuclear Power Plant was damaged by the Great East Japan Earthquake and subsequent tsunami. As a result, radioactive substances were released from the damaged plant into the environment. This accident, as well as the Chernobyl nuclear accident, have demonstrated that nuclear disasters may affect not only the countries in which they occur, but also other countries around the world through the spread of the radioactive substance pollution. Therefore, it is necessary to strengthen the international cooperation network for radiation emergency medicine. However, this field is presently facing a scarcity of human resources. It is thus important for us to educate young people who have knowledge and skills in radiation emergency medicine.

As many nuclear facilities are located in our country, it is necessary to prepare for such accidents by fostering human resources who have knowledge and skills in radiation emergency medicine. Since 2009, the Hirosaki University Graduate School of Health Sciences has held the International Symposium on Radiation Emergency Medicine every year. This event featured lectures by invited speakers from abroad, and an introduction of Hirosaki University's Radiation Emergency Medicine activities to the audience. In 2013, we decided to shift

the symposium to “for and by” young scientists and re-branded the event as the 1st Educational Symposium on RADIATION AND HEALTH by Young Scientists (ESRAH2014).

Sixty-six researchers from 11 countries gathered for ESRAH2014 and engaged in vigorous discussions on a variety of radiation-related presentations. In addition, we offered four educational lectures for young researchers delivered by four authorities on radiation sciences: Dr. James McLaughlin (University College Dublin, Ireland), “General Principles of Radiation Protection”; Dr. Jing Chen (Health Canada, Canada), “Issues and Challenges of Radiation Risk Communication to the Public”; Dr. Michaela Kreuzer (Federal Office for Radiation Protection, Germany), “Principles of Radiation Epidemiology”; and Dr. Siamak Haghdoost (Stockholm University, Sweden), “Biological Effects of Gamma Radiation with Focus on Low Dose and Low Dose Rates”. Additionally, a panel discussion on “Radiation and Health” was coordinated by Dr. Haruyuki Ogino, Central Research Institute of Electric Power Industry, Japan.

The young scientists made 90 second-oral presentations summarizing their research; this was followed by poster discussions. The research theme covered a broad range of topics on basic and applied research. There were a total of 38 abstract submissions, including 5 papers on medical treatments, 5 papers on the Fukushima nuclear accidents, 11 papers on biological effects, and 17 papers on radiation measurements. The details on these subjects are shown in Table 1.

From these presentation, 4 papers were selected for

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Table 1. Data concerning the radiation exposure of workers in the cave

No.	Title	Authors	Affiliation
1	Innovative neutron shielding material composing of natural rubber-styrene butadiene rubber blends and diborontrioxide for shielding secondary neutron emission from linac therapy with multileaf collimators	C. Jumpee and D. Wongsawaeng	Chulalongkorn University, Thailand
2	Comparison of Meperidine and Fentanyl on pain scale and quality of life in cervical cancer patients receiving brachytherapy: A double-blind, randomized controlled trial	S. Thanthong, S. Rojthamarat, N. Ieumwananontachai, W. Worasawate	Rangsit University, Thailand Chulabhorn Hospital, Thailand Siriraj Hospital, Thailand
3	Pooled Bayesian meta-analysis of two polish studies on radiation induced cancers	K.W. Fornalski	PGE EJ 1 Sp. z o.o., Poland
4	A graphical method for selecting the optimal number of fractions and dose per fraction for fractionated radiotherapy	Y. Sugano, M. Mizuta, S. Takao, H. Shirato, K.L. Sutherland, H. Date	Hokkaido University, Japan
5	Monte Carlo simulations of proton beam irradiation of gold particles	J. Kwon, K.L. Sutherland, T. Hashimoto, H. Date	Hokkaido University, Japan
6	Radiological considerations on surface contamination control after the Fukushima Nuclear Disaster	H. Ogino and T. Hattori	Central Research Institute of Electric Power Industry, Japan
7	Reproduction of in vivo measurements of ¹³¹ I in thyroids of emergency workers involved in the Fukushima nuclear accident by numerical simulation	K. Tani, O. Kurihara, E. Kim, K. Sakai, M. Akashi	National Institute of Radiological Sciences (NIRS), Japan
8	Sentiment analysis for Twitter about radiation after the Fukushima nuclear power plant accident	M. Ohta, N. Nishimoto, K. Ogasawara	Hokkaido University, Japan. Hokkaido University of Science, Japan
9	Estimating information attenuation on nuclear radiation accident among population	N. Nishimoto, M. Ohta, K. Ogasawara	Hokkaido University of Science, Japan Hokkaido University, Japan
10	Allogeneic umbilical cord blood transplantation for acute high-dose total body X-ray exposure in mice	H. Maeda, K. Terui, H. Ajima, M. Nakano, K. Ito, K. Ito	Hirosaki University, Japan
11	Study of 4-methylumbelliferone as inhibitor of metastasis on X-irradiation	R. Saga, S. Monzen, H. Yoshino, M. Chiba, T. Nakamura, Y. Hosokawa.	Hirosaki University, Japan
12	Effects of the rehabilitation on the skin damage and the range of motion of the rats with X-ray irradiated hind limbs	S. Koeda, H. Narita, K. Ito, K. Ito, H. Tsushima	Hirosaki University, Japan
13	Changes in skin surface temperature and erythema intensity during and after radiotherapy for breast cancer patients	Y. Fukushi, M. Kitajima, C. Itaki, Y. Noto, K. Mikami, Y. Hirota, K. Katto, Y. Mariya	Hirosaki University, Japan Hirosaki Central Hospital, Japan
14	Expression analysis of radiation responsive genes in human hematopoietic stem/progenitor cells	T. Tsujiguchi, T. Hirouchi, S. Monzen, Y. Tabuchi, I. Takasaki, T. Kondo, I. Kashiwakura	Hirosaki University, Japan Institute for Environmental Sciences, Japan University of Toyama, Japan
15	Dose rate effects of standard X-rays exposure on biological cells	Y. Matsuya, Y. Yoshii, K. Sasaki, H. Date	Hokkaido University, Japan Hokkaido University of Science, Japan
16	A computational approach to the DNA damage induced by electron tracks using the DBSCAN algorithm	Y. Yoshii, Y. Matsuya, K. Sasaki, H. Date	Hokkaido University, Japan Hokkaido University of Science, Japan
17	Evaluation of oxidative stress markers in plasma derived from individuals exposed to ionizing radiation	A. Nishiyama, M. Yamaguchi, T. Tsujiguchi, S. Murakami, I. Kashiwakura	Hirosaki University, Japan
18	Assessment of background radiation level in Garhwal Himalaya, India	M. Yadav, M. Prasad, R.C. Ramola	H.N.B.Garhwal University, India
19	Measurements of indoor Radon, Thoron and their progeny concentrations using indigenous pin-hole dosimeter and direct progeny sensor techniques	M. Prasad, M. Yadav, R.C. Ramola	H.N.B Garhwal University, India
20	Distribution of artificial radionuclides in agricultural soil at different profiles	N.B. Sarap, M.M. Jančković, M.M. Rajačić, J.D. Nikolić, Ž.K. Dolijanović, D.J. Todorović	University of Belgrade, Serbia
21	Geochronology of the Iacob Lake (Danube Delta) by the Pb-210 and Cs-137 dating methods	R.C. Begy, H. Simon, S. Kelemen, I. Steopoaie	Babes-Bolyai University, Romania
22	Alternative statistical methods of dose estimation from mixed irradiation after nuclear accidents	I. Pacyniak, M. Kowalska, K.W. Fornalski	Central Laboratory for Radiation Protection (CLOR), PGE EJ 1 Sp. z o.o., Poland
23	Radon-222 concentration of groundwater in central part of Thailand using ultra low level liquid scintillation counters	P. Lerdwanangkun, W. Boomyarak, W. Montree, P. Pakkong, M. Jitpakdee	Kasetsart University, Thailand
24	Transmission of light through recoiled proton tracks in polycarbonate	S. Asavaphatiboon, N. Chankow, D. Wongsawaeng	Chulalongkorn University, Thailand
25	Estimating the effect of radiation aerosol deposition by using the numerical methods: A preliminary study	Yan-Lin Liu	National Tsing-Hua University, Taiwan, R.O.C.
26	Development and performance test of passive radon personal dosimeter	Y. Watanabe, S. Tokonami, M. Janik, M. Hosoda, K. Iwaoka	Hirosaki University, Japan National Institute of Radiological Sciences, Japan

27	Radiation dosimetry for the internal exposure of the cats in Namie-Town	Y. Fujishima, A. Nakata, T. Miura, H. Tazoe, T. Toyoda, K. Kasai, K. Ariyoshi, M. Yamada, N. Konno, M.A. Yoshida	Hirosaki University, Japan Hokkaido Pharmaceutical University, Japan Namie-Town Office, Japan
28	Spatial distribution of radon and thoron concentrations in Japanese houses	Y. Ito, M. Hosoda, K. Iwaoka, S. Tokonami	Hirosaki University, Japan
29	Numerical simulations of atmospheric dispersion of Iodine-131 emitted from a point source	R. Mészáros, Á. Leelőssy, I. Lagzi, T. Kovács	Eötvös Loránd University, Hungary Budapest University of Technology and Economics, Hungary University of Pannonia, Hungary Social Organization for Radioecological Cleanliness, Hungary
30	Preparation and characterization of ceramic based Thoron sources for Thoron calibration chamber	A. Csordás, F. Fábián, M. Horváth, M. Hegedüs, J. Somlai, T. Kovács	Social Organization for Radiological Cleanliness, Hungary University of Pannonia, Hungary
31	Intercomparison of calibrated CR-39 track Thoron progeny detectors by active Thoron devices under on-site circumstances	G. Bátor, F. Fábián, E. Tóth-Bodrogi, A. Csordás, J. Somlai, T. Kovács	Social Organization for Radioecological Cleanliness, Hungary University of Pannonia, Hungary
32	Study of polonium content in cigarette smoke	M. Horváth, E. Tóth-Bodrogi, G. Bátor, T. Kovács	University of Pannonia, Hungary Social Organization for Radioecological Cleanliness, Hungary
33	Natural radionuclide content of norm by-products originated from coal fired power plant	Z. Sas, R. Kardos, J. Szántó, A. Shahrokhi, J. Somlai, T. Kovács	University of Pannonia, Hungary
34	Effects of ionizing radiation on differentiation and induction of murine bone marrow-derived mast cells	S. Murakami, H. Yoshino, J. Ishikawa, M. Yamaguchi, T. Tsujiguchi, A. Nishiyama, K. Yokoyama, I. Kashiwakura	Hirosaki University, Japan Oita University of Nursing and Health Sciences, Japan
35	Long-lasting radioprotective effect of a combination of pharmaceutical drugs on the survival of mice exposed to lethal ionizing radiation	K. Yokoyama, T. Hirouchi, M. Yamaguchi, A. Nishiyama, S. Murakami, I. Kashiwakura	Hirosaki University, Japan Institute for Environmental Sciences, Japan
36	Determination of the locality of the decayed Radon originated from Mill Tailings (UMTS) in different layers of remediated Uranium tailing pond	J. Jónás, J. Somlai, Z. Sas, A. Várhegyi, Z. Gorjanác, T. Kovács	University of Pannonia, Hungary MECSEKERC Zrt., Hungary
37	Simultaneous determination of Radon/Thoron exhalation of heat-treated red mud mixed clay samples	Z. Sas, R. Kardos, J. Jónás, M. Hegedüs, A. Shahrokhi, J. Somlai, T. Kovács	University of Pannonia, Hungary
38	Optimization in the dosimetry using the Cytokinesis-block micronucleus assay	A. Nakamura, S. Monzen, Y-K, Takasugi, A. Wojcik, Y. Mariya	Hirosaki University, Japan Stockholm University, Sweden

the poster awards: 1) S. Thanthong, *et al.* Comparison of Meperidine and Fentanyl on pain scale and quality of life in cervical cancer patients receiving brachytherapy: a double-blind, randomized controlled trial; 2) J. Kwon, *et al.* Monte Carlo simulations of proton beam irradiation of gold particles; 3) H. Ogino and T. Hattori. Radiological considerations on surface contamination control after the Fukushima nuclear disaster; and 4) R. Kardos, *et al.* Natural radionuclide content of norm by-products originated from coal fired power plant. The abstracts from these papers are shown below.

1) Comparison of Meperidine and Fentanyl on pain scale and quality of life in cervical cancer patients receiving brachytherapy: a double-blind, randomized controlled trial. S. Thanthong, S. Rojthamarat, N. Ieumwananontachai, W. Worasawate (Rangsit University, Chulabhorn Hospital, Thailand)

The American Brachytherapy Society recommended conscious sedation in patients receiving brachytherapy. Two commonly used opioids are meperidine and fentanyl. Many studies have compared effects of the two opioids in patients with endoscopy, colonoscopy, gastrointestinal

endoscopy, post-thoracotomy and upper gastrointestinal tract ultrasound endoscopy. However, such comparison has yet been reported in patients receiving brachytherapy. The objective of this study is to compare the pain level and quality of life of the two sedation regimens consisting of diazepam in combination with meperidine or fentanyl. A total of 40 patients (160 fractions of brachytherapy), unselected brachytherapy out patients at Chulabhorn Hospital, were enrolled with informed consent and randomized to receive meperidine or fentanyl. Data of perceived pain (according to standard 10-cm visual analog scales [VAS]), and perceived Quality of life (EQ-5D) were collected. Patients and all brachytherapy staffs directly involved with the procedure were blinded about the drug used. The main outcome of the study is to measure the experience of pain (VAS score) and the quality of life. The studied results shown that pain was significantly lower in patients receiving meperidine than in those receiving fentanyl ($P = 0.033$), whereas there was no difference in quality of life between the two groups.

2) Monte Carlo simulations of proton beam irradiation of gold particles. J. Kwon, K.L. Sutherland, T. Hashimoto, H. Date (Hokkaido University, Japan)

In image guided proton therapy (IGPT), gold particles are used as implanted fiducial markers. Gold nanoparticles (GNPs) have also been considered to be utilized because of their potential capability as a radiosensitizer. In these applications of gold particles, the production of secondary electrons from gold atoms by the irradiation is of importance because it may cause dose perturbations and damage to adjacent tissues. However, there are few analyses concerning these interactions. The purpose of this study is to make clear the kinetics of secondary electrons from gold particles under proton irradiation. Physical processes of the collision between gold particles and protons (including secondary electron production and nuclear reactions) were simulated with the Geant4 Monte Carlo simulation toolkit. A spherical gold particle was located at the center of a liquid water cube, 0.5 cm each side. As a tentative test, the radiuses of gold particles were assumed to be 0.1, 0.25, 0.5, and 1 mm. The proton energies were 40 MeV, 60 MeV, 80 MeV, and 100 MeV. The gold particles were irradiated unidirectionally by the proton beam. Secondary electrons were produced in abundance behind the gold particle by the proton beam irradiation. As the radius of the gold sphere increases, and as the beam energy increases, the number of the secondary electrons increased to form a shadow region where electron energies are deposited. It was observed that energy distribution of the electrons has a maximum at about 10 keV regardless of the proton beam energy and particle size, suggesting a high probability to cause damage to the peripheral tissues through low energy electron processes. The electron production ejected from gold atoms encourages us to make careful treatment planning when gold particles are used as fiducial markers for IGPT. However, if we utilize GNPs in the tumor tissue, the electrons from the gold are essential for the radiosensitizing effect.

3) Radiological considerations on surface contamination control after the Fukushima nuclear disaster. H. Ogino, T. Hattori (Central Research Institute of Electric Power Industry, Japan)

There has been a great deal of public concern about revised regulation criteria and health effects associated with exposure to low doses of ionizing radiation after the Fukushima Daiichi nuclear disaster. The Nuclear Safety Commission of Japan judged that it is appropriate to apply the concept of reference levels developed by the International Commission on Radiological Protection (ICRP) in its 2007 Recommendations to the long-term consequences of the accident. In the ICRP radiation

protection system, the dose-response model is based on the assumption that radiation doses greater than zero will increase the risk of stochastic effects (i.e., excess cancer and heritable disease) in a simple proportionate manner, and accordingly, there is no threshold for stochastic effects. The concept of reference levels can be applied to emergency and existing controllable exposure situations, above which it is judged to be inappropriate to plan to allow exposure to occur, and below which the optimization of protection should be implemented by determining the level of protection that makes exposure, and the probability and magnitude of potential exposure, as low as reasonably achievable, taking economic and societal factors into account. In this respect, we discussed radiological issues associated with the surface contamination control after the Fukushima nuclear disaster in the poster presentation. The screening level for decontamination initially applied to the surfaces of the human body and contaminated objects was verified by assessing the doses that arise from external irradiation, ingestion, inhalation and skin contamination. In the verification, the annual effective dose that arises from handled objects contaminated with the screening level for decontamination (i.e., 100,000 counts per minute) was set at 1 mSv, which can be considered as a lower bound of the reference level and the intervention exemption level in accordance with the ICRP recommendations. Furthermore, operational surface contamination levels for unconditional release were proposed in counts per minute (cpm) on the basis of the surficial clearance level of 10 Bq cm⁻² for ¹³⁴Cs and ¹³⁷Cs derived in previous studies of the authors. The operational levels for unconditional release were proposed to be 2,300 cpm on average and 23,000 cpm in the area with highest contamination. Note that these operational levels are effective provided that a typical Geiger-Muller (GM) survey meter with a 50 mm bore is used in the screening measurement.

4) Natural radionuclide content of norm by-products originated from coal fired power plant. Z. Sas, R. Kardos, J. Szántó, A. Shahrokhi, J. Somlai and T. Kovács (University of Pannonia, Hungary)

As a result of energy production in coal fired power plants huge amount of by-products produce. In Thermal Power Plant of Oroszlány (Hungary) different techniques have been used since 1961 to burn brown-coal with various quality can be found in the vicinity of Oroszlány. On the basis of previous studies it was found that several Hungarian coal have elevated natural radionuclide content can be enhanced as a result of burning. In this survey coal and deposited by-product samples were examined (fly-ash, bottom-ash, fluidized bed bottom-ash, gypsum, slurry-type ash). The natural radionuclide content was determined by high resolution gamma ray spectrometry,

using an ORTEC GMX40-76 HPGe detector. The data and spectra recorded by a Tennelec PCA-MR 8196 MCA. To get information about the distribution of radionuclide content in function of the grain size distribution the bottom ash – deposited in the largest quantity – was fractionized and examined as well. The natural radionuclide content of the coal ($^{226}\text{Ra} = 45.3 \pm 6.3$; $^{232}\text{Th} = 26.3 \pm 5.7$; $^{40}\text{K} = 210 \pm 21$ Bq/kg) is significantly lower than in case of originated ashes except in case of fluidized type. The gypsum originated from the desulphurization process has very low natural radionuclide content ($^{226}\text{Ra} = 22.2 \pm 3.4$; $^{232}\text{Th} < \text{LD}$; $^{40}\text{K} = 13 \pm 2.7$ Bq/kg). The average radionuclide content of the bottom ash was ~3 times higher than the coals' ($^{226}\text{Ra} = 144 \pm 18$; $^{232}\text{Th} = 84.3 \pm 14$;

$^{40}\text{K} = 260 \pm 25$ Bq/kg). In case of the fractionized samples it was found that the radionuclide content under 0.1 mm was 45% higher than above 1.6 mm.

The two-day gathering demonstrated the high quality and various fields of radiation research. The symposium concluded with many of the young scientists forming new friendships and networks. The next conference, ESRAH2015, is scheduled to take place again in Hirosaki, under the direction of Prof. Hiroyuki Date, Hokkaido University, Japan.

Photographs from various events are included at the end of this report.



Educational lectures



Panel discussion



Poster presentation and discussion