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Report

Introduction of the Radiation Emergency Medicine Course at REAC/TS and Impressions of It from the Viewpoint of Medical Students

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Since 2008, Hirosaki University has been running several projects on radiation emergency medicine for the preparedness in radiation and nuclear accidents. Within the framework of these projects, staff members of Hirosaki University have participated in the Radiation Emergency Medicine Course at the Radiation Emergency Assistance Center/Training Site (REAC/TS) in the USA since 2009. In 2019, some medical students of Hirosaki University got the first opportunity to attend the training course conducted by REAC/TS. Radiation Emergency Medicine course was mainly emphasized on the practical aspects of initial hospital management for the patients who were exposed and/or contaminated through lectures and hands-on practical exercises. In addition to radiation knowledge, having the same training with people from different occupations, languages and cultures gave us valuable experiences in deepening communication abilities. All of us had a very exciting and fulfilling time during our stay in REAC/TS.

Key words: radiation emergency medicine, training course, REAC/TS, medical student, Hirosaki University

1. Introduction

Aomori Prefecture has a nuclear power plant (NPP) and Japan's first commercial nuclear fuel cycling facilities[1]. The operation of the Higashidori NPP was stopped after the Fukushima Daiichi NPP accident in 2011. Furthermore, the construction of the Oma NPP was also suspended at that time, but will be planning re-start from 2020[2].

Since 2008, Hirosaki University has been running several projects on radiation emergency medicine for preparedness in radiation and nuclear accidents[3, 4]. One project on radiation emergency medicine human resources was established by the Graduate School of Health Sciences and ran from 2008 to 2012. This project was continued until 2016 under a new name, "Advanced Human Resources Development Project for Radiation Emergency Medicine". Additionally, "Education Program for Professionals in Radiation Emergency Medicine" was also established in a five-year project starting from 2010. This project was operated by the Institute of Radiation Emergency Medicine, Graduate School of Medicine and Graduate School of Health Sciences. Currently, the "Nuclear Regulatory Human Resources Development Project" is being run by the Institute of Radiation

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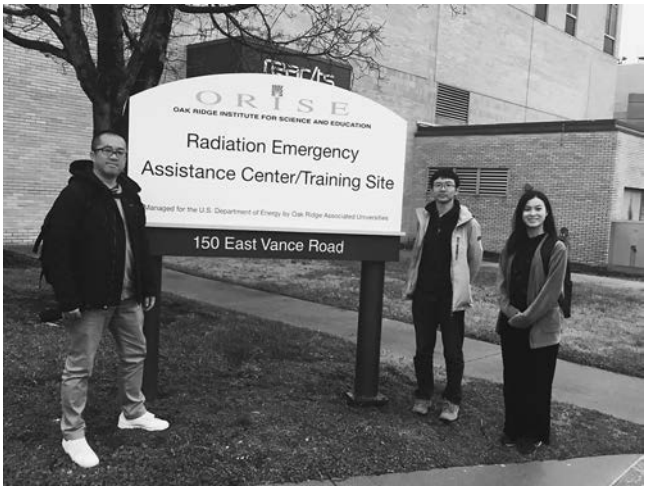

Fig. 1. Group photo in front of the building of REAC/TS (from left to right: Masahiro Hosoda, Mitsuaki Yoshino (medical student), Remi Tokonami (medical student)).

Fig. 2. Participants attending the opening lecture.

Emergency Medicine and Graduate School of Health Sciences.

Immediately after the Fukushima NPP accident, members of the Radiation Safety Council at Hirosaki University discussed a strategy for responding to the radiological health conditions of residents affected by the accident[5]. Then, Hirosaki University staff members were dispatched to Fukushima Prefecture so as to support people living there. The first team from Hirosaki University, which consisted of radiation experts, nurses and office workers, was dispatched to Fukushima Prefecture on 15 March 2011. This team and others after it carried out surface contamination screening tests for beta-particle contamination for the general public in Fukushima Prefecture using Geiger-Müller (GM) survey meters. This support was continued until the end of July 2011. A total of 20 teams supported the residents and almost 5000 residents were examined.

Through these activities, Hirosaki University was selected as an advanced radiation emergency medical support center and nuclear emergency medical support center by the Japanese Nuclear Regulation Authority in 2015[6, 7]. As a result, the development of radiation emergency medicine human resources has become more important for not only medical workers (e.g., nurses and radiation experts), but also medical doctors. Therefore, in 2019, Hirosaki University dispatched some medical students to the Radiation Emergency Medicine Course at the Radiation Emergency Assistance Center/Training Site (REAC/TS) in Oak Ridge, Tennessee (Fig. 1) to provide a wider range of training experiences in radiation emergency medicine. This was the first chance for students of the university to attend the course, although staff members of Hirosaki University have participated since 2009[8]. In this short paper, we give an overview of the Radiation Emergency Medicine training course at REAC/TS. Furthermore, we give impressions of the training course from the viewpoint of medical students.

2. Overview of training course

Table 1 shows the timetable of the four-day Radiation Emergency Medicine Training Course in which we participated for an overview.

2.1. Summary of the first day

After the acceptance of all the participants was completed, first an opening lecture "Introduction to REAC/TS" was given by the director, Dr. Carol J. Iddins (Fig. 2). The work of REAC/TS includes advice and consultation for radiation exposure medical treatment, radiation dose evaluation based on health physics knowledge, placement of emergency response teams, possession of records on emergency radiation medical incidents for radiological research, possession and management of chelating agents and Prussian Blue, and related activities. In addition, many training courses on radiation emergency medicine are organized.

The lecture on "Basic Health Physics" started from the basics of radiation and was a review of what was taught in the radiation emergency medicine course of the Institute of Radiation Emergency Medicine in the latter half of the second year for students in the School of Medicine. "Basic Radiation Biology" was a lecture on radiation sources around people in their daily lives, the process of radiation energy transfer to cells, radiation sensitivity, and chromosomal aberrations. The lecture entitled "A History of Radiation Accidents 1945-2019" involved the topics of

Table 1. Timetable of Radiation Emergency Medicine Training Course

Date	Time	Topic
12 Feb. 2019	7:45	Registration
	8:00	Introduction to REAC/TS (30 min)
	8:40	Basic Health Physics (60 min)
	9:50	Basic Radiation Biology (70 min)
	11:10	History of Radiation Accidents (60 min)
	13:15	Basic Radiation Instrumentation (Laboratory exercise) (120 min)
	15:25	Acute Radiation Syndrome (ARS) (60 min)
	16:25	Team Organization (45 min)
	17:30	Social Dinner
13 Feb. 2019	8:00	Common Sources of Radiation (60 min)
	9:10	Management of Internal Contamination (60 min)
	10:20	Local Radiation Injuries (60 min)
	11:30	Dose Magnitude Estimation (60 min)
	13:30	Hospital Response to Radiation (60 min)
	14:40	Walk-through/Demonstration (60 min)
	15:50	Skills Station I & II (70 min)
14 Feb. 2019	8:00	Local Injury Case Reviews (60 min)
	9:10	Emergency Drill (Group A)/ Tour of the New American Museum of Science and Energy (Group B) (110 min)
	11:10	Emergency Drill (Group B)/ Tour of the New American Museum of Science and Energy (Group A) (110 min)
	13:00	Working Lunch at REAC/TS; Review Emergency Drill Videotape (60 min)
	14:00	Drill After Action (45 min)
	14:50	Case Study: Tokai-Mura (60 min)
	16:00	RAP Response (60 min)
15 Feb. 2019	8:00	Nuclear Reactors Accident Case Studies (50 min)
	9:00	Goiania (50 min)
	10:00	Public Information in Radiation Accidents (90 min)
	11:30	Question and Answer Session/ Exam Review (30 min)

where and why radiation accidents occur and the most commonly related radiation sources and devices.

"Basic Radiation Instrumentation" was the only practical experience on the first day. In this, the lecture explained the structure of a GM survey meter and how to handle it, and participants worked in pairs to actually conduct measurements of alpha, beta and gamma-rays from standard sources using the GM survey meter. The training contents included the discrimination method of each quality of radiation by the GM survey meter, and the identification of a contamination source in the room and on a simulated human body using simulated sources. A commentary on how to handle condenser-type pocket dosimeters was also given; such devices are worn as a personal exposure dosimeter.

The practice was followed by another lecture, "Acute Radiation Syndrome", on signs and symptoms, diagnostic procedures and clinical stages of acute radiation syndrome, pathological findings and examination methods of acute radiation syndrome, and the role of emergency medical specialists in the initial management of exposed patients. The last session on the first day was called "Team Organization." After a brief explanation, participants organized teams for the third day practice. Each team consisted of a team leader, a medical doctor, a nurse, a recorder, a radiological technologist (radiological survey) and a recorder (medical scribe), and a boundary controller (control line). We three were supposed to take part in the third day drill as the nurse, recorder and boundary controller. After all the lectures on the first day, a dinner party was held at a nearby restaurant with all the participants, hosted by the REAC/TS staff. At the dinner party, we could deepen professional friendships with the lecturers, and participants from different countries and occupations. Although we were the only medical students attending, many participants talked to us and we were able to interact with various people. As a result, the atmosphere of the lecture room became more relaxed on the second day.

2.2. Summary of the second day

The morning program began with the topic "Common Sources of Radiation" which were classified into industrial use, medical use, and general consumer goods. The lecture gave a lecture while showing the actual simulated dose to participants. We learned that radiation is widely used in a variety of fields from which we came to realize the importance of radiation. The lecture on "Medical Management of Internal Contamination" presented the classification of internal exposure pathways, characteristics of each pathway and the evaluation method of internal exposure dose. This lecture

Fig. 3. Demonstration of Hospital Response to Radiation Events.

Fig. 4. Photos showing the emergency drill team members with a victim.

emphasized how to use Diethyl Triamine Pentaacetic Acid (DTPA) and Prussian Blue and so on, and we were encouraged to use this knowledge on the third day in the team emergency drill exercise.

The lecture on "Cutaneous Radiation Syndrome/ Local Radiation Injury" was given using photos of actual acute local radiation damage, which were helpful for us to understand diagnosis and management. In the lecture on "Early Radiation Dose Magnitude Estimation" we participants realized again the difficulty of dose evaluation of internal exposure. A video about the atomic bomb was played while having a working lunch. As Japanese, we felt the seriousness of the atomic bomb experiences and thought it was important to deepen our knowledge further. The lecture on "Hospital Response to Radiation Events", also intended as preparation for the team emergency drill exercise on the third day, revealed important points in the series of events from pre-emplacement to movement of the patient in a radiation emergency. The lecture particularly emphasized what life-saving treatments are top priorities. Then, a demonstration was conducted by lecturers (Fig. 3). The lecturers gave a paper of questions to everyone that were to be answered and turned in on the last day. The lecturers urged us to work together smoothly on the third day in the drill. In the session "Skill Station" we were divided into several groups and we had a meeting related to the team exercise of the third day.

2.3. Summary of the third day

The third day started with "Local Injury Case Reviews". We were able to know about local radiation injuries and radiation accidents. The team training "Emergency Drill" and "Tour of the New American Museum of Science and Energy" took place in the morning (Fig. 4 and Fig. 5). participants were put into two groups A and B, and the schedule was alternated for them. We went on the museum tour after the training. In the training, a scenario was distributed to the team leader and we had a time-out to understand the scenario. The scenario outline consisted of a blast accident at a manufacturing plant handling radioactive materials. There were two injured persons, a woman and a man, who had not been decontaminated, and they were conscious and would arrive soon. After the time-out, we changed to Tyvek wear and put on a personal dosimeter and a face shield.

According to the protocol, we proceeded with undressing, radiation source estimation, red surveillance, nasal sampling, decontamination, whole body search, and decontaminant order. For both injured persons, radioactive material was removed from the trauma site. The woman was also identified as having a contamination source on the skin of her upper right thorax. The wound was washed with saline and the skin contamination source was decontaminated by application of a decontamination cream. In addition, X-rays were taken for both patients who complained of trauma or headache to search for fracture. After the protocol treatment was completed, we removed our Tyvek wear by the standard procedure and performed a full-body measurement on each other. After confirming that no one was contaminated, the drill ended. After the drill, we visited the New American Museum of Science and Energy.

The museum was appealing in its contents that

Fig. 5. New American Museum of Science and Energy.

displayed the history of atomic bomb production, uranium enrichment methods, and basic scientific explanations, such as what are elements, how are supercomputers used, and what are next-generation energies. During the "Working Lunch at REAC/TS", we watched a 45-minute documentary about the link between Oak Ridge and the Manhattan Project and we had the exercise "Review Emergency Drill Videotape". Based on the training, we made one presentation for each role and we got feedback from the lecture. The lecture "Case study: Tokai-Mura" started with a case report on an exposure accident that occurred in 1999 in Yanango, Peru as an introduction. Then, the criticality phenomena that caused the Tokai accident were explained. The follow-up and exposure estimation were explained while comparing each patient, so it was an easy-to-understand lecture. "RAP Response" explained the Radiological Assistance Program (RAP). RAP is one of the primary response programs in an emergency and performs dosimetry and environmental surveys by the American federal and local governments. In the lecture, not only emergency activities, but also other past activities were introduced.

2.4. Summary of the fourth day

The "Nuclear Reactions Accident Case Studies" dealt with the accident at Three Mile Island, Chernobyl and Fukushima Daiichi Nuclear Power Plant as case reports. How each of these power plant accidents occurred, the releases of radioactive materials to the atmosphere after the accidents, the responses at the accident sites, and other details of each accident were covered. "Goiania" described the radioactive material theft case from the hospital which went out of business in Goiania, Brazil in September 1987. In "Public Information in Radiation Accidents" participants were told about issues in dealing with the media and communications in case of an emergency. In the "Question & Answer Session/ Exam Review" we turned in our answers to the questions and heard the correct answers to them. The training was completed after this session was finished.

3. Impressions from attending the training course

There are three points we students learned as participants from this REAC/TS training course. First, we both thought teamwork was very important. In the drill carried out on the third day, we formed a team, then organized and practiced responses to an accident scenario. Since we used protective wear on our faces, it was very difficult for us to communicate with each other. In order to save patients, however, not only medical workers but also many people such as emergency services and radiation specialists were involved. Therefore, communication was important under this situation. We thought it would be good to further develop our communication skills. Second, we were surprised to learn that various industries are involved in the field of radiation science. There were various participants in this REAC/TS, including, physicians, nurses, radiation experts, persons from the military, and so on. Even during the lecture, not just in the Q & A, they actively raised their hands and asked questions. We felt Japanese people still lack knowledge about radiation. It is important for many people to acquire knowledge about radiation. Third, we all realized our English skill need to be improved. While talking with other participants, we understood what they said, but it took much time to reply to them because we spoke after forming English sentences in our minds. At present, globalization is attracting attention even in Japan. As students, we saw the need to acquire further English skills.

While we had slight differences in our reasons for participating as students in this course, we had a number of shared reasons described as follows. 1) To get a more

practical correspondence between radiation medicine that we learned in classes in Hirosaki University and real-world situations. 2) To improve our English skills for clinical training. 3) To have an identity as a Hirosaki University student.

For reason 1), we thought that it is not enough to actually do such simulation training in Japan. In addition to the fact that the simulation was more realistic by using actual protective wear and using actual radiation sources, there were differences in participants' cultures, occupations and languages, as well as the medical systems. In the training, we felt that it was sometimes difficult to understand the situation at the emergency site and our ability to keep up with the task was lacking somewhat. We cannot say with confidence that we always took the best action. However, if we have learned one thing as a medical students and participants, it was the importance of thinking about and acting for the patient. The awareness that professionals sometimes concentrate too much on their own work and they cannot recognize other people and patients is very valuable.

Reason 2) was achieved by receiving this training in the US. English skills were required for lectures and communicating with other participants, and we sometimes felt that we were not good at English during the training period. It may be difficult to secure time to study English, but we would like to actively increase our opportunities to experience English in various ways.

As for reason 3), this training has become a valuable experience. After returning, we have talked to students from other universities. Dispatch of students to REAC/TS is as an advanced approach, and one of the distinctive activities of Hirosaki University. As mentioned above, although the training schedule was quite substantial and not physically easy, we felt that all the reasons from 1) to 3) which were set initially were achieved in a wonderful way. Medical treatment and radiation are always close, and radiation accidents are not necessarily major disasters. From that viewpoint, it was very meaningful to learn about various topics including the acute treatment of exposed patients in this training. In addition to radiation knowledge, having the same training with people from different occupations, languages and cultures gave us valuable experiences in deepening communication abilities.

4. Conclusion

In February 2019, two medical students of Hirosaki University and one faculty member got the great opportunity to learn about radiation emergency medicine in the described training course at REAC/TS. This is the first-time medical students of the university have participated. Certainly, all of us had a very exciting and fulfilling time during our stay in REAC/TS and we found new members from different countries to add to our respective professional networks.

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