

Radiology at the Heart of Disaster in Japan

What is the radiologist's role when the unthinkable happens?

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The March 11th earthquake and subsequent disasters in Japan were so massive that they can be considered national crises. Radiologists were required to address this situation differently from other cases of natural disasters because of instrumentation failures, power outages, and the uniqueness of the diseases contracted by the tsunami victims. We were also asked to respond to or offer advice regarding issues of radiation exposure that resulted from the nuclear accident at the Fukushima Daiichi nuclear plant. In this article, I present the activities of the radiologists from the Tohoku University Hospital.

When Disaster Strikes

The earthquake occurred at 2:46 on March 11, 2011. All 200 V-power sources went down and the emergency power systems kicked in. One of the PET-CT units and portable x-ray equipment were the first systems in operable condition. Immediately after the earthquake, we ensured the safety of our patients who were stanching bleeding after angiography, maintaining a urethral stent, and undergoing vascular access procedures for CT scans. MRIs were





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also aborted by radiology technicians to ensure patient safety. Non-ambulatory patients were transferred on stretchers. On that day, PET-CT was used for two patients. At the time of the earthquake, I was outside on duty at a Red Cross hospital in Ishinomaki City where the tsunami inflicted tremendous damage. Staying away from the devastated coastal areas, I returned to Sendai by taxi via inland roads. The traffic signals were too dark to check the situation at the university hospital. Then, I went to my apartment in the city to confirm the safety of my wife and children.

Early the following morning, Saturday, March 12, I obtained some water and other necessities for my family and joined the disaster headquarters meeting to hear reports from each division and explain our policies in the radiology department. When the power was restored at approximately 11:00, four CTs, two MRIs, and most of the instruments for general radiography, fluoroscopy, and angiography were operable. Unfortunately, the PET scan machine remained inoperable because of damage to the door of the cyclotron. A triage system was put in place for outpatients. Because the ordering system and image referral system could not immediately be used, the radiologists stayed beside the CT in the emergency room to read the images and provide comments in real time. Orders were made by entering triage IDs on paper request forms. Key images were printed on a maximum of two dry films per patient. Even after the recovery of the ordering and image referral

systems, filmless procedures could not be used for patients without a Tohoku University Hospital ID. Paper request forms and films were used for patients who were referred from triage.

At the university hospital, lifelines such as water and electricity were recovered, but the staff had to prepare their own meals. The available staff had to go shopping and cook meals in the radiology technologists' room in the radiology department. Some relief supplies were distributed from the hospital to each division that evening. The people were waiting patiently for their turn in a long, orderly queue at the rare supermarkets that were still open. I feel very proud of the Japanese people who helped one another maintain peace and order.

Making the Critical Next Steps

On Sunday, March 13, the ordering system was recovered and a meeting was held to discuss the examination policy. We decided that the university hospital would not receive ordinary outpatients, rather only earthquake-related and emergency patients. All appointments for CT, MRI, nuclear medicine, angiography, and fluoroscopy for outpatients and inpatients were cancelled. CT, MRI, and angiography were performed only for urgent cases. Because the hospital's PHS system was often interrupted due to antenna problems, some radiologists were assigned phone extensions to provide consultations for each department. The university hospital

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assumed the role of a behind-the-lines center by dispatching support doctors to the affected areas and receiving patients transported from affected areas. Less urgent patients were discharged from the hospital to increase the number of available beds.

By Monday, March 14, the first work day after the earthquake, we anticipated confusion with returning patients and disaster patients. However, because of limited transportation and gasoline, the number of patients that we received was less than expected. Although the radiology department was expecting the secondary or tertiary transportation of many trauma patients, many of the people who were engulfed in the tsunami died and the condition of many of the survivors was relatively mild. Many of the outpatients presented with hypothermia, infection, or were elderly with chronic diseases. With the peculiarities of the tsunami disaster, we performed only a small number of trauma-related IVRs and image diagnoses. Considering the difficulties communicating through mobile phones, three radiologists stayed on duty, which included one on-duty radiologist, one angiography radiologist, and one radiologist recruited for triage assistance and back-up services.

We also formed a radiation contamination countermeasures team with radiologists and radiology technicians after the nuclear accident occurred and cooperated with the Miyagi prefectural government. The team performed simple screening for radioactive material contamination for people who had evacuated from the 30-km area surrounding the Fukushima Daiichi nuclear power plants and decontaminated those who presented with high levels of radiation exposure. We also measured and reported radiation levels within the university hospital. Decontamination was performed in the PET examination room after covering the floor and walls with sheets. To address mental health care and prevent harmful rumors, we issued certificates to show that no contamination was detected on the subjects who underwent screening or decontamination. Few people exhibited levels above the threshold. The levels were lowered to below the threshold in most cases simply by taking off jackets or shoes. During the week of March 14, the remaining MRIs were recovered, and the examination system returned to normal. Irradiation for radiotherapy was resumed very quickly from March 16 onward.

The next Monday, March 21, we began to receive returning patients again. We established a hotline for appointment consultations to prevent confusion because we were receiving both patients who had appointments for the present week and patients who had appointments from the previous week. By the middle of the week, a total of 155 CT and MRI examinations per day were performed, which was about 80% of our normal capacity.

By March 28, our practice almost returned to normal. With the resumption of elective surgeries, IVR was resumed, which had been

lagging. In the second series of patient arrivals from the coastal areas that were affected by the tsunami, image diagnoses for patients with inflammation or pneumonia caused by long-term evacuation or dust inhalation were more frequent than usual. Preoperative image diagnoses of patients with neoplastic disease, image diagnoses of thrombosis, and IVR of aggravated arterial disease were also performed.

Rebuild, Renew, Restore

The earthquake disaster that we experienced was massive. My impression is that image diagnosis during this disaster was considerably different from past disasters. Sadly, many people died before receiving necessary image diagnosis or medical care after the onset of infection or for aggravated chronic disease. After being asked for advice regarding radiation exposure by many people, I understood the importance of having basic knowledge of the effects of radiation. After our disaster headquarters meeting every morning, I realized that an entire university hospital took consolidated action and every department made their utmost efforts to provide medical care and resume normal operations. I was also impressed that each department and division, including laboratories, nurses, nutrition, IT centers, and clerical aides, fulfilled their crucial roles and reported their results simply and succinctly.

Five months have passed since the earthquake, and Tohoku University Hospital has recovered to a nearly normal practice structure. However, we still have patients with tsunami-related pneumonia or infectious disease in the affected coastal areas. We are expecting a long recovery period. Moreover, some parents of small children are experiencing anxiety regarding radiation exposure. To help allay their concerns, I have given lectures on radiation exposure to parents and teachers of elementary school children.

After the earthquake, we were greatly encouraged by the warm support from radiologists from around the world. Many academic societies and medical device manufacturers have given our university and the affected areas various support, such as providing portable ultrasound devices and many other instruments and devices for free. We have used these tools for screening of deep-vein thrombosis and other conditions. We sincerely appreciate this support. The rehabilitation process is expected to take a long time, and we gladly welcome your continued cooperation, support, and advice.

I would like to express my sincere, heartfelt sympathy to the victims of the Great East Japan Earthquake and their families. My respect and gratitude are also extended to all of the people who engaged in medical practice during this emergency and those who provided various other support activities. ■