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Editors

Radiation Disaster Medicine

Perspective from the Fukushima Nuclear Accident
“Radiation emergency medicine,” in the modern sense of the word, began in Japan with the reception, triage, and overall medical management of three victims from the Tokai-mura criticality accident in 1999. Following this event, Japan’s radiation emergency medical preparedness and response system had been drastically restructured. It was the system unique to Japan, coincident with its Emergency Medical Services (EMS) system, and comprised the echelon of facilities and care from primary to tertiary. At the same time, a well-structured training program has been actively carried out since 2001, targeting medical, EMS personnel, local officials, and others for the first response to radiological emergencies. The assumed worst scenario was that of the Three Mile Island Nuclear Power Plant accident. One drawback was that the system as well as training and even the drills were in effect only in localities where the nuclear facility was located. Thus, the system could have been termed that of “radiation emergency medicine.”

Then the Fukushima Daiichi Nuclear Power Plant accident occurred, combined with the earthquake and subsequent tsunami. Admittedly, it caused great confusion in the immediate medical response because it was far beyond what had been expected and planned. However, the medico-social responses in Fukushima were nothing really new but something revisited. Things similar to what has been done in Fukushima in terms of disaster medical response were first practiced in the Chernobyl disaster in the former Soviet Union in 1986 and thereafter and then in the 1987 Goiania accident in Brazil. Namely, there were various radioprotective measures for the public and the environment on an extremely large scale where some medical involvement was inevitably required: sheltering, evacuation, stable iodide administration, radiation survey, decontamination, food and water restriction, relocation, etc.

Thus, the medical management of the various aspects of a nuclear disaster in its acute stage such as practiced in these events can be defined as “radiation disaster medicine.”

It is not just “radiation emergency medicine” but encompasses the medical involvement in those activities unique to nuclear disaster in addition to common issues with other disasters. Theoretically it can be considered as the on-scene application of knowledge and skills, among others, in emergency medicine, disaster medicine, radiology, psychiatry, and public health. In actuality, however, we have not discussed or studied systematically this area of the comprehensive medico-social response to a combined natural and nuclear disaster.
From the Tokai-mura criticality accident experience, we learned that the human network established ahead of time was crucially important to better deal with the difficult situation since the human resources in this field were scant. Most authors of this book have known each other through this human network and are credible experts small in number.

There are a few textbooks or manuals on radiation emergency medicine; however, they are not always based on the actual experience, have not stood the test of time, and usually presuppose an intact medical system.

In a sense, this book is the first effort of its kind. This book is not just a textbook but contains the actual descriptions of what responders and others had to do or what they have found at various points in time and at various places during and after this unprecedented, most severe nuclear accident in history. A nuclear accident causes far greater sociopsychological effects than other disasters, and it is well known that equal emphasis should be placed on psychological and physical health care of the affected.

Physicians and medical personnel may be driven to play the key role in communicating with the public in the relevant and timely fashion to alleviate their anxiety and fear.

These two important aspects of the medical response to a nuclear disaster are well described in this book, and the chapters serve as a good reference. Readers can better understand what actually happens in a radiation disaster, particularly caused by a major nuclear power plant accident. Readers may also refer to this book as the “ABC” in radiation disaster medicine as they prepare for the worst nuclear disaster scenario. It is hoped that readers will find this a useful reference.

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Preface

There are many books available on “Disaster Medicine,” but to the best of our knowledge, there is currently no book available that addresses “Radiation Disaster Medicine.” The idea for this book was born from a discussion between the two editors while attending the “International Academic Conference on Radiation Health Risk Management in Fukushima” held in Fukushima on 25–27 February 2013. The two of us have had frequent interactions with physicians from Fukushima Medical University, Hiroshima University, and Nagasaki University and a few other medical institutions in Japan. We have come to learn that during the initial phase of the accident, physicians and Japan Disaster Medical Assistance Teams provided medical relief in an extremely difficult environment; infrastructure including medical, transportation, water and electricity supplies, and communication systems were disrupted. We were impressed by the courage and sacrifice demonstrated by frontline responders. They provided emergency services in the midst of the combined disasters, putting their own life at risk, while the extent of radiation risk was still unknown.

The book *Radiation Disaster Medicine* provides an overarching conceptualization of the problem based on what we have learned from the Fukushima accident in particular which we believe will offer guidance for medical management during the acute phase of a radiation disaster. The concept includes understanding physicians’ roles in radiation disasters (from micro and macro perspectives), imbuing lessons from past radiation disasters, and preparing for future radiation emergencies.

No clear definition of radiation disaster medicine has been articulated after the Chernobyl and Three Mile Island accidents. The radiation emergency medical system developed in Japan after the Three Mile Island and JCO accidents did not offer sufficient breadth or depth to manage the Fukushima accident, which was further complicated by the destruction caused by the combined natural disasters. Thus, many physicians were not sufficiently prepared to manage the Fukushima accident. This book offers an emphasis on medical and psychological readiness that is essential in mitigating any radiation disasters. Additionally, although no death from acute radiation syndrome was encountered in the Fukushima accident, there were unexpected casualties during evacuation and marked difficulties in medical management even though they were unrelated to radiation. An overarching purpose of this book is therefore to broaden the lens, examine the unique challenges that physicians face, and introduce readers to some key institutions in radiation disaster situations.
This book employs a comprehensive approach that includes medical basics and social considerations, covers all levels of emergency care (primary, secondary, tertiary), and clarifies common issues and specific considerations in radiation and other disasters. It is to be noted that this book should not be perceived as excluding disaster medical responses for other disasters but that it is especially focused on radiation disasters. *Radiation Disaster Medicine* is intended for health-care professionals, prehospital emergency care providers, and emergency personnel involved in responses.

Through this book, readers can better understand what happens in radiation disaster in order to provide appropriate management and care for those injured, evacuees, and residents. Knowledge of radiation disaster medicine is made up to date for health-care professionals in all fields, as well as recommended to be included into medical school curriculum for capacity building. Finally, an expected outcome would be minimization of confusion and misconceptions among emergency personnel and residents in the case of another radiation disaster.

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# Contents

1. **Physicians’ Early Response to the Fukushima Daiichi Nuclear Power Plant Accident: Challenges and Lessons Learned** .......................................................... 1
   Rethy Kieth Chhem

2. **General Considerations in Radiation Disaster Medicine** ............... 15
   Koichi Tanigawa

3. **Medical Perspective** ................................................................. 29
   Koichi Tanigawa and Arifumi Hasegawa

4. **Disaster Behavioral Health: Psychological Effects of the Fukushima Nuclear Power Plant Accident** ............................... 79
   Masaharu Maeda and Misari Oe

5. **Management Perspective: Structure of Radiation Emergency Response in Japan** .............................................................. 89
   Takako Tominaga, Misao Hachiya, and Makoto Akashi

   Azura Z. Aziz and Pisith Phlong

7. **Radiation Disaster Medicine Curriculum Revisited in a Post-Fukushima Context** ..................................................... 109
   Rethy Kieth Chhem, Azura Z. Aziz, and Gregory K. Clancey

Index ........................................................................................................... 121
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Abbreviations

ALARA    As Low as Reasonably Achievable
ARS    Acute Radiation Syndrome
APSTSN    Asia-Pacific Science, Technology and Society Network
CBRNE    Chemical, Biological, Radiological, Nuclear, and High-Yield Explosives
CDPC    Central Disaster Prevention Council
DMAT    Disaster Medical Assistance Team
DRD    Disaster-Related Death
ED    Emergency Department
ER    Emergency Room
FAO    Food and Agricultural Organization
FMU    Fukushima Medical University
GM    Geiger-Mueller
HS    Hematopoietic Syndrome
IAEA    International Atomic Energy Agency
ICRP    International Commission on Radiological Protection
IEC    Incident and Emergency Centre
IEComm    Operations Manual for Incident and Emergency Communication
ILO    International Labour Organization
INES    International Nuclear Event Scale
IO    International Organizations
JAAM    Japan Association for Acute Medicine
JFA    Japan Football Association
JMAT    Japan Medical Association
JPLAN    Joint Radiation Emergency Management Plan of the International Organizations
JSDF    Japan Self-Defense Force
LET    Linear Energy Transfer
LOC    Level of Consciousness
LRI    Local Radiation Injury
MCE    Mass Casualty Events
NAHU    Division of Human Health
NEA    Nuclear Energy Agency
NIRS    National Institute of Radiological Sciences
Abbreviations

NPP    Nuclear Power Plant
NRA    Nuclear Regulation Authority
NSC    Nuclear Safety Commission
OCHA   The Office for the Coordination of Humanitarian Affairs
OFC    Off-site Center
PB     Persian Blue
PNC    Power Reactor and Nuclear Fuel Development Corporation
PPE    Personal Protective Equipment
PTSD   Post-traumatic Stress Disorder
RANET  Response and Assistance Network
REA    Radiation Emergency Area
REMAT  Radiation Emergency Medical Assistance Team
SPEEDI System for Prediction of Environmental Emergency Dose Information
START  Simple Triage and Rapid Treatment
STS    Science and Technology Studies
TEPCO  Tokyo Electric Power Co.
TMI    Three Mile Island
UNEP   United Nations Environment Program
UNSCEAR United Nations Scientific Committee on the Effects of Atomic Radiation
UPZ    Urgent Protective Action Planning Zone
WHO    World Health Organization
WMO    World Meteorological Organization