Role of Emergency Medical Technicians on Radiation Accidents

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Abstract

Taiwan is a small island, but she has 4 nuclear power plants (including 3 active nuclear reactors and the other one is building now). Although the likelihood of a major accident at a nuclear power plant is low, should such an accident occur, protective and save actions near the facility would need to be taken to protect the public. The emergent medical technicians provide on-site medical assistance and help direct or transport people to medical facilities. An efficient and systematic delivery of EMS saves lives, reduces disability, and should contain all of the following components: rapid, reliable public access to emergency medical services; dispatch of the appropriate ambulance unit to the scene of injury; appropriate on-scene emergency medical care; rapid transport to an appropriate emergency care facility; and continuity of care until the injured person is either admitted to an acute care facility or discharged. *(Ann Disaster Med. 2003;2 Suppl 1:S38-S45)*

Key words: Emergency Medical Technician; Radiation; Disaster

Introduction

In recent years, accidents at several nuclear power plants have proven such events can lead to the widespread discharge of radioactive materials into the environment. Additionally, acts of domestic terrorism involving chemical and biological weapons have recently occurred, raising fears about the intentional use of a radioactive device against a civilian population. Because of these threats, there is a need for emergency medical technicians (EMT) to become more informed about the issues that would occur in the case of a significant radiological event.[1,2]

History

Several historical events have shaped our understanding of the consequences of radiation disasters.[3,4]

1. There were come radiation accidents of unknown origin and late recognition; for example, Goiania, Brazil in 1987; Tammiku, Estonia in 1994; Lilo, Georgia in 1997; Istanbul, Turkey in 1998/99; Samut Prakarn, Thailand in 2000; Meet Halfa, Egypt in 2000.
2. Accidents of known radiation origin have ever occurred; for example, Gilan, Iran in 1996, and Yanango, Peru in 1999.

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3. Accidental exposure in medical applications (e.g., Zarragosa, Spain, 1990; Costa Rica, 1996; Panorama, 2001)
4. Criticality accidents (e.g., Sarov, Russia, 1997; Tokaimura, Japan, 1999)
5. Nuclear accident with transboundary effects (Chernobyl, USSR, 1986)
6. Nuclear accident with produced negligible doses among people living nearby. Three Mile Island (TMI), 1979); The TMI accident brought into question the safety of nuclear power plants and the potential consequences of a power plant mishap. Immediate administration of potassium iodide (KI) was recommended for those living near TMI, but it was not available.[5] There were no biological effects of the exposure but significant psychologic sequelae occurred.

Sources of Potential Radiation Threat

Radiological threats can be unintentional or intentional. Unintentional threats include power plant disasters such as Chernobyl and TMI.[4,5] Intentional threats are associated with military conflict or terrorism. The major types of radiation disaster threats are nuclear power plant accidents, nuclear weapons accidents, international incidents involving radioactive materials, lost (orphaned) radiation source devices, acts of terrorism involving nuclear materials, and accidents involving satellites containing radioactive material.

Any of these occurrences could result from human error or terrorist activity. The most important of these risks is the potential for release of radioiodines into the environment. Additionally, spent reactor fuel rods, which are typically retained by the nuclear power plant for many years, present a radiation hazard that is distinct from an incident that releases a radioactive cloud.

Consequences of a Radiation Disaster

Radiation biology

In nuclear reactor accidents involving the release of radioactive material into the atmosphere, the following routes resulting in radiation injury to the population are expected:[6,7]

1. External gamma irradiation brought by the passing radioactive cloud;
2. Internal irradiation from inhaling radioactive aerosols (inhalation hazard);
3. Contact radiation due to deposition of radioactive fallout on the skin and clothes;
4. Total external gamma irradiation of the population due to deposition of radioactive fallout on the soil and local objects (buildings, constructions etc.);
5. Internal irradiation resulting from water consumption and local food products contaminated by radioactive substances.

Health effects

Health effects after a radiation exposure will depend greatly on the circumstances surrounding the release.[8] For example, after detonation of a nuclear weapon or radioactive dispersal device, there may be thermal or blast injury in addition to radiation exposure. In contrast, a nuclear power plant disaster can produce a radioactive cloud with no associated blast.

Specific health outcomes after radiation exposure are typically divided into short-term and long-term; short-term effects appear within days to weeks after exposure, and long-term effects appear months to years later. Short-term effects are dependent on the degree of radia-

tion exposure and the tissue irradiated. The general symptoms appear after exposures as little as 0.75 to 1.0 Gy (75-100 rad), like nausea, vomiting, anorexia, diarrhoea, weakness, headache, dizziness and/or fatigue associated with lymphopenia appear in combination (within 2 days following an exposure of large part of the body). At a later stage (2–4 weeks after the accidental exposure to radiation source), they progress to simultaneous leuko- and thrombopenia, leading to gingival bleeding, epistaxis and petechiae as well as infectious complications; a hematopoietic syndrome (severe lymphoid and bone marrow suppression) typically appears after 3.0 to 6.0 Gy.

Three Ways to Minimize Radiation Exposure

There are three factors that minimize radiation exposure to human body: time, distance, and shielding.

1. Time--Most radioactivity loses its strength fairly quickly. Limiting the time spent near the source of radiation reduces the amount of radiation exposure a person will receive. Following an accident, local authorities will monitor any release of radiation and determine the level of protective actions and when the threat has passed.
2. Distance--The more distance between a person and the source of the radiation, the less radiation a person will receive. In the most serious nuclear power plant accident, local officials will likely call for an evacuation, thereby increasing the distance between a person and the radiation.
3. Shielding--Like distance, the heavier, dense materials between a person and the remain indoors if an accident occurs. In some cases, the walls in the home or workplace would be sufficient shielding to protect a person for a short period of time.

Preparing for a Radiation Disaster

Radiological emergencies require a multi-disciplinary team who can track, contain, and cleanup a radioactive release, while protecting people and the environment around the emergency site. Emergency response personnel include scientists and engineers, health physicists, emergency medical technicians (EMTs), laboratory staff, and other emergency response specialists.[9]

The special medical needs of victims make it essential that EMTs be prepared for radiation disasters, including 1) the detonation of a nuclear weapon; 2) a nuclear power plant event that unleashes a radioactive cloud; and 3) the dispersal of radionuclides by conventional explosive or the crash of a transport vehicle. Any of these events could occur unintentionally or as an act of terrorism. Nuclear facilities (eg, power plants, fuel processing centers, and food irradiation facilities) are often located in highly populated areas, and as they age, the risk of mechanical failure increases. The EMTs has an important role in planning for radiation disasters. For example, potassium iodide is of proven value for thyroid protection but must be given before or soon after exposure to radioiodines, requiring its placement in ambulances and offers it to victims on scene.

Initial Emergency Management - Guidelines for Emergency Medical Technicians[10,11]

1. Approach site with caution--look for evidence of hazardous materials.

2. If radiation hazard is suspected, position personnel, vehicles, and command post at a safe distance (approx. 150 feet) upwind and uphill of the site.
3. Notify proper authorities and hospital.
4. Put on protective gear and use dosimeters and survey meters if immediately available.
5. Determine whether injured victims are present. Do diagnostic measures to consider in victims of radiation exposure.
6. Assess and treat life-threatening injuries immediately (Figure). Do not delay advanced life support if victims cannot be moved or to assess contamination status. Perform routine emergency care during extrication procedures (eg. Neck collar, long-back board).
7. Move victims away from the radiation hazard area, using proper patient transfer techniques to prevent further injury. Stay within the controlled zone if contamination is suspected.
8. If trauma is present, treat. Expose wounds and cover with sterile dressings.
9. Victims should be monitored at the control line for possible contamination only after they are medically stable. Radiation levels above background indicate the presence of contamination. Remove the contaminated accident victims' clothing, provided removal can be accomplished without causing further injury.
10. Move the ambulance cot to the clean side of the control line and unfold a clean sheet or blanket over it. Place the victim on the covered cot and package for transport. Do not remove the victim from the backboard if one was used.
11. Package the victim by folding the stretcher sheet or blanket over and securing them in the appropriate manner.
12. Before leaving the controlled area, rescuers should remove protective gear at the control line. If possible, the victim should be transported by personnel who have not entered the controlled area. Ambulance personnel attending victims should wear gloves.
13. Transport the victims to the hospital emergency department. The hospital should be given additional appropriate information, and the ambulance crew should ask for any special instructions the hospital may have.
14. Follow the hospital's radiological protocol upon arrival.
15. The ambulance and crew should not return to regular service until the crew, vehicle, and equipment have undergone monitoring and necessary decontamination by the radiation safety officer.
16. Personnel should not eat drink, smoke, etc., at the accident site, in the ambulance, or at the hospital until they have been released by the radiation safety officer.
17. Contamination control to prevent the spread of radioactive materials from: [11,12]
    - The patient: In most circumstances the victim will be the source of the contamination; however, in rescue and extrication, some contamination may have been transferred to others.
    - The rescue personnel
    - The gurney and equipment used in patient care (stethoscope, BP cuff, etc.)
    - The ambulance
18. This contamination can be transferred to:
    - Care providers as they touch or move the patient to correct the medical problem

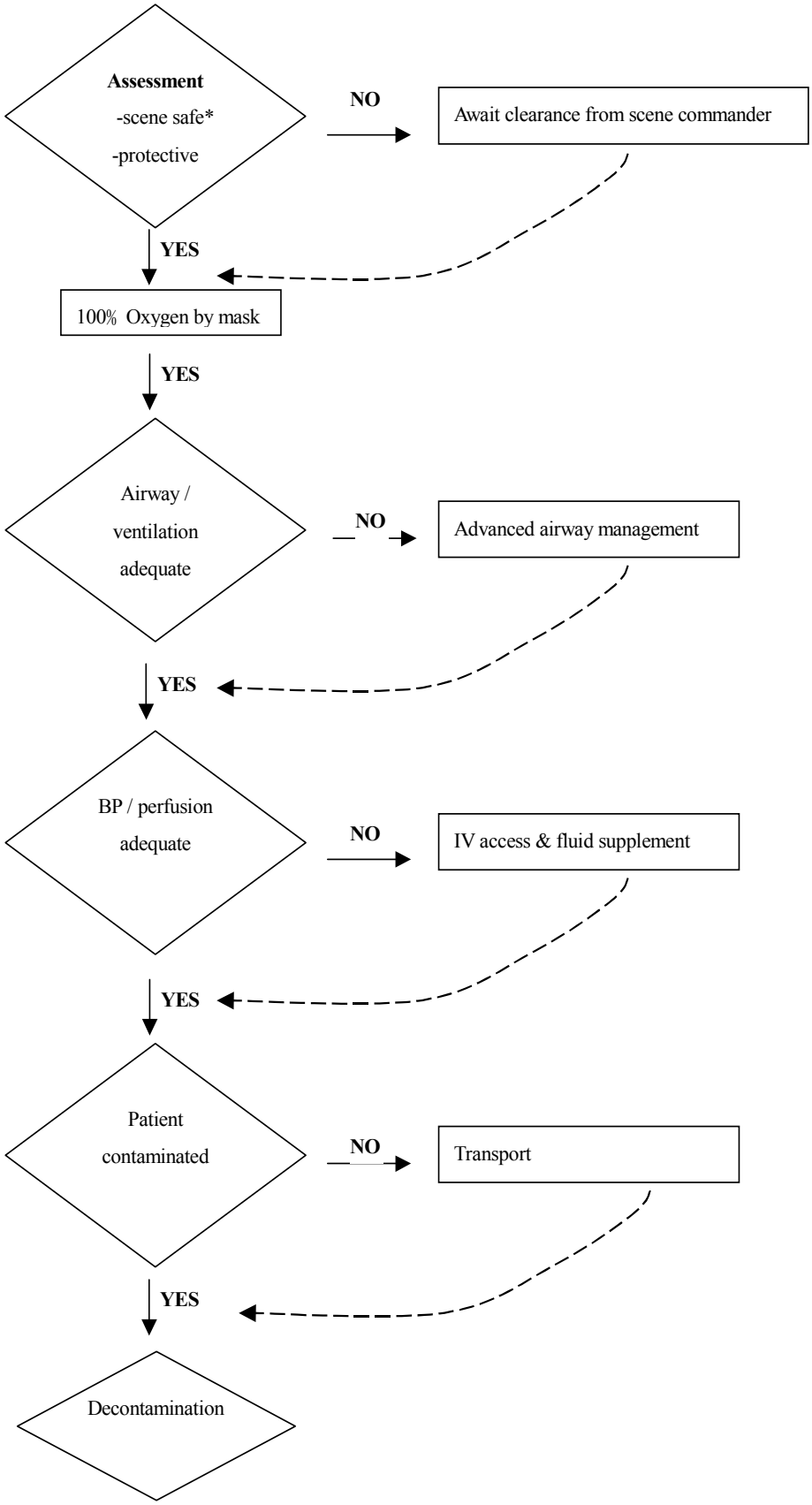

Figure. Assessment of victims suspected with radiation injury

- The equipment used to assess the patient's condition and to treat the medical emergency
- The surrounding area (treatment gurney, floor, etc.)
- In rare cases where dust or powders are present, the air could contain radioactive particles[12]

From the above discussion, the recommendations for EMTs on radiation accident are as follows:

1. EMTs should increase their knowledge about emergency medical aspects of radiation exposure.
2. EMTs should become familiar with local preparedness and evacuation protocols and work with public health agencies on their development.
3. EMTs should assist local schools and community in developing protocols to reunite people in the event a disaster.
4. All EMTs at risk should receive Potassium Iodide (KI) before exposure, if possible, or immediately afterward. This will require that KI be available in place located within 10 miles of a nuclear power plant. Facilities within 10 miles of a nuclear power plant should plan to stockpile the agent. It may be prudent to consider stockpiling KI within a larger radius because of more distant windborne fallout, as occurred after Chernobyl; this will be determined by local and national public health authorities.[5,13]
5. The risks and benefits of using KI should be understood and discussed with patients. KI is available without a prescription, and families should be cautioned against using the medication before consulting with authorities.[14]
6. The EMTs should recognize and respond to the physical and psychosocial consequences of disasters on victims.

Conclusion

There is a low chance for most of the EMTs to meet a patient with symptoms of acute radiation injury during their professional career. However, in case of observation of the above described non-specific symptoms and signs, it is necessary to bear in mind – besides the usually diagnosed intestinal infection, food poisoning, allergy, or insect bite – their radiation origin as an alternative cause. It can be suspected independently of the unawareness of the accidental exposure by the patient. Radiation injury should not be ruled out today when improper registration, loss of control, unauthorised possession, smuggling or even criminal and terrorist use of radiation sources might, and occasionally does, occur.

Hence, each EMT has to be prepared to recognize and initially respond to radiation injuries. Specialists of radiohygiene, radiation medicine and public health must take the lead in conducting regular postgraduate training and medical education to successfully compete with this task.[15]

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緊急醫療救護員在輻射意外事故的角色

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摘要

台灣不過是個蕞爾小島，卻擁有三座正在運轉中和一座興建中的核能電廠。雖然核能電廠發生重大事故的機會很低，一但事故發生，我們必須立刻採取保護和拯救的行動，以確保社會大眾的生命安全。緊急醫療救護員提供現場的醫療協助工作和指引或運送病患到醫療機構就醫，一個有效力的系統的緊急醫療系統能拯救生命，降低失能的產生，並且應該涵蓋以下所有的要件(元素)：大眾快速並可靠獲得的緊急醫療系統派遣勝任的救護單位到達災變現場；提供事故現場正確的緊急醫療照顧；迅速轉送(後送)到適當的緊急醫療機構；並且持續照顧直到病人住院或出院。*(Ann Disaster Med. 2003;2 Suppl 1:S38-S45)*

關鍵詞：緊急醫療救護員；輻射；災變

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