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Brief Report

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Simulated transport time and distance from nuclear power plant to nearest university hospital in Korea

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ABSTRACT

Background: Nuclear accident has a possibility of many injured people and requires urgent transfer to hospital. We investigated simulated transport time and distance from nuclear power plant to nearest university hospital by motor vehicle in Korea.

Methods: This study was based on scenario design. Transport time and distance was measured on internet mapping service. We decided less than one hour is optimal on estimated arrival by motor vehicle.

Results: Four nuclear power plants and twenty four nuclear reactors are operating in Korea. Each estimated arrival time to nearest university hospital is 37 min, 47 min, 1 hour 32 min and 2 hours 37 min, respectively (Gori, Wolsung, Yeonggwang and Uljin). Measured distance is 25, 27, 69 and 157 kilometers, respectively.

Conclusions: Gori and Wolsung nuclear power plants require other hospital in close location or more rapid transport system.

Keywords: Nuclear power plant, Transport time, Korea

INTRODUCTION

Nuclear energy is in use worldwide because of low cost and global warming after first commercial nuclear power station in 1956. South Korea has 26 operating nuclear reactors for electricity production in 2016. Nuclear power plant is a massive structure itself to need lots of workers for construction and maintenance. There is always a danger of injury in operation, also threat of natural and artificial disaster- war, terrorism, earthquake, tsunami and accident.

Nuclear accident requires immediate transfer to tertiary hospital for trauma and radiation care. We investigated that simulated transport time and distance from nuclear power plants to nearest university hospitals by motor vehicle in South Korea.

METHODS

This study was conducted on scenario-based design. We simulated this study at the simulation laboratory in our hospital from July to October 2015. All nuclear power plants and university hospitals were included for this study. Nuclear power plants are located in four regions in South Korea. But all nuclear power plants are in immediate proximity to the sea, they are far from big cities where university hospitals are located. We estimated transport time and distance from each nuclear power plants to nearest university hospitals by online map service. We supposed that roads were expected not

to be damaged for smooth traffic. The two closest university hospitals from each power plant were considered to transport. Optimal time was assumed within one hour for appropriate medical treatment.

RESULTS

Four nuclear power plants and twenty-six nuclear reactors are operating in South Korea. Each estimated arrival time to nearest university hospital is 37 min, 47 min, 1 hour 32 min and 2 hour 37 min, respectively (Gori, Wolsung, Yeonggwang and Uljin). All of nuclear power plants and distance to nearest university hospital were listed in Table 1. Gori and Wolsung can be transported to university hospital within one hour. However, Yeonggwang and Uljin are not possible to be transported in one hour.

Table 1: The simulated transport time and distance from nuclear power plant to university hospital.

Nuclear power plant	Operating reactors	University hospital	Distance (kilometers)	Expected transport time
Gori	6	Inje Univ. Hosp.	28.52	37 min
		Ulsan Univ. Hosp.	36.73	58 min
Wolsung	6	Ulsan Univ. Hosp.	27.89	47 min
		Dongguk Univ. Hosp.	41.53	59 min
Yeonggwang	6	Chonnam Univ. Hosp.	69.03	1 h 32 min
		Chosun Univ. Hosp.	70.66	1 h 37 min
Uljin	6	Dongguk Univ. Hosp.	157.24	2 h 37 min
		Wonju Severance Hosp.	211.96	3 h 2 min

DISCUSSION

Nuclear power plant has a possibility to produce catastrophe like Chernobyl and Fukushima upon occasion. Chernobyl disaster happened in Ukraine, 1986. Many people of them had an exposure of radiation.⁴ The number of death was 28 people in several months, and the maximum was estimated as 25,000 people. Japanese government evacuated 100,000 people from Fukushima nuclear power plant after 2011.5 Many fugitives from bombed area have not returned to their residence six years later.

The transportation to the hospital from nuclear power plant must be under consideration as care for trauma and radiation exposure. Trauma has various causes like falls, burn, blast, and unintentional motor vehicle injury in power plant.⁶ Severe injured patients have to be transferred to trauma center within one hour for proper treatment. 7,8 Level 2 or 3 trauma center is not suitable for trauma care of severe injured patient. Direct transportation to level 1 center showed high survival rate. University hospital is considered as level 1 center in terms of medical equipment and personnel, South Korea.

Radiation exposed patient with or without traumatic insult requires special care. According to increase of terrorism or accident, the government has to be prepared for potential of exposure of large scale incidents. 10 Acute radiation syndrome needs proper treatment upon several subsyndrome like hematopoietic, gastrointestinal, and cerebrovascular system. ¹¹ Usually 50% lethal dose of radiation is about 5.5 Gy. Urgent and immediate care is essential over this value. Biodosimetry methods would be good technique to determine for mass casualty of radiation disaster. 12

Twenty-six nuclear reactors are operating in South Korea. The number of nuclear reactors is ranked the sixth in the world. The portion of nuclear generation is also ranked the third after France and Ukraine. Gori and Wolsung nuclear power plants have two university hospitals with one hour transportation. However, it is not possible to be transported within one hour from Yeonggwang and Uljin power plant to university hospital. This simulation is based on the assumption of no influence in transportation condition like traffic jam and road destruction. Yeonggwang and Uljin power plants require new university hospital near or need improvement of road to Chonnam and Dongguk university hospital, located away 69.03 and 157.24 km respectively (Table 1). Gori power plant has 1.7 million populations in a radius of 20 km. Haeundae beach is nearly located and most populated about one million in summer season, South Korea.¹³ Evacuation plan has to be established for large scale incident.

CONCLUSION

Yeonggwang and Uljin nuclear power plants do not have university hospitals within one hour by motor vehicle. So, patients with severe trauma or radiation exposure from these nuclear power plants may not get proper treatment.

Therefore, construction of additional hospitals or roads to existing hospitals are required for care of trauma patients.

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