Original Article

Capacity of operating room in the occurrence of tsunami on Haeundae Beach, Korea

Kwang Rae Cho, Yong Han Kim, Hyun Chul Joo, Sang Yoon Jeon, Jae Wook Jung, Ki Hwa Lee, Jin Soo Kim, Ki Hoon Kim, Seung Soo Kim

Department of Anesthesiology and Pain Medicine and Surgery, Busan Paik Hospital, Inje University, Busan, South Korea

Objective: To investigate of damaged persons and available operating rooms (OR) in Busan and neighboring cities under the assumption of Tsunami in Haeundae Beach, Korea.

Methodology: We assumed that 30 percent of 120,000 people were damaged and the number of deaths, missing and injured persons was estimated 32%, 18%, 50%, respectively. The classification of injured patient was mild 70%, moderate 25% and severe 5%. 25% of the moderately injured and 20% of the severely injured were triaged to classified patients who did not need a surgery. The number of operating room is 121 university hospital OR and 266 general hospital OR in Busan and neighboring cities.

Results: There were 11,520 deaths, 6,480 missing and 18,000 injured: mild 12,600, moderate 4,500, severe 900 patients. The patients who need surgery are total 4095 people. The acceptable surgical case per hospital was 5.95 cases in University Hospital and 12.68 cases in other hospitals. Maximal capacity of surgery for 24 hours was 3,192 cases in moderate group, 726 cases in severe group. This amounts to 94.5% (3192/3375) and 100.8% (726/720), respectively in comparison with expected cases.

Conclusion: OR is sufficient in Tsunami of Haeundae, but medical personnel and transport system should be inspected. (Rawal Med J 2014;39:277-280).

Keywords: Tsunami, Injury severity score, triage, operating room, Busan.

INTRODUCTION

A tsunami is a series of water waves caused by the displacement of a large volume of a body of water.[1] It usually arises in an ocean though it can occur in large lakes. Earthquakes, volcanic eruptions, underwater explosions, landslides, glacier calvings and other mass movements can generate a tsunami. This huge catastrophe causes heavy casualties. Many of them have severe injuries; therefore demand immediate surgical operation and critical care. All kinds of injury pattern can be detected skull, brain, spine, pelvis, extremity, thorax, abdomen, crash, drowning and inhalational injuries.[2]

Korean peninsula was regarded to safe zone from natural disaster like earthquake and tsunami. However, interest in disaster plan is increasing recently. The movie titled 'Haeundae' based on tsunami became a blockbuster and has attracted a cumulative audience of 8 million in Korea.[3] Tohoku earthquake and tsunami attacked the northeast coast of Honshu Island, Japan in March 2011. Fukushima nuclear power plant exploded on the next day.[4] Radiation leaked from nuclear plant after a blast blew its roof off. We supposed that tsunami would occur on high season in Haeundae Beach where the movie 'Haeundae' was set. Haeundae Beach is located in Busan, second largest city in Korea. Busan is on the Pacific and the opposite side of Japan. It was investigated how many operating rooms are available in Busan and neighboring cities on emergency basis after tsunami.

METHODOLOGY

Haeundae beach (gross area 72,000m^2) and coastal area can be capable of 120,000 persons in peak season. It is assumed that 30 percent of maximum capacity was affected from tsunami. The number of dead, injured and missing person was divided to 32%, 50%, 18%, respectively based on the outcome of Thailand 2004 Tsunami on report of World Health Organization.[5] The triage of the injured was categorized into three groups; mild (70%), moderate (25%) and severe (5%) by reference of the casualties in Krabi province, Thailand, 2004 Tsunami.[6] Mild injured patients would be transferred to the clinic

managed by general practitioner or received primary treatment in the field. Moderate wounded patients would be transported to the general hospital. Severe injured people should be moved to the university hospital.

Surgery may not be necessary in patients like concussion, chest tube insertion, near drowning, and spinal cord injury. The proportion of non-surgical treatment was presumed as 25% of moderate group and 20% of severe group. Estimated time of operation was 2 hours in moderate group and 4 hours in severe group on average, including anesthesia. The Injured was transferred from the disaster area to the hospital by ambulance or other vehicles. It was assumed that medical institution, personnel, road and transport vehicle would not be damaged. We obtained hospital list to receive help from Busan Emergency Medical Information Center.

RESULTS

Estimated fatalities were 11,520. 6,480 people were predicted missing, and 18,000 people were wounded in hypothetical disaster. Mild, moderate and severe group of the injured was 12,600 4,500 and 900 people respectively. 3,375 people of moderate and 720 people of severe injured would have an operation immediately. Triage was according to ICRC (Table 1).

Table 1. Total number of operating rooms (OR) in Busan and neighboring cities excluding primary clinic.

City	Population	University hospital OR	Hospital OR	Total OR
Busan	3,554,635	82	163	245
Ulsan	1,134,125	12	38	50
Changwon	1,092,085	13	41	54
Gimhae	506,243	0	18	18
Yangsan	265,999	14	6	20
Total	6,553,087	121	266	387

Population was obtained by report of Statistics Korea (March 1st 2012). The number of operation room was received from Busan Emergency Medical Information Center (March 1st 2012).

Available operating rooms were 121 rooms in Busan and 266 rooms in neighboring cities (Table 1). The number of operation per room was 5.95 cases in university hospital and 12.68 cases in general hospital.

Table 2. Triage categories used in ICRC hospitals.[2,7]

Category I – Priority for Surgery Those patients for whom urgent surgery is required and for whom there is a good chance of reasonable survival.
Category II – No Surgery Those patients who do not require surgery. (This includes both patients with wounds so slight that they do not need surgery and those who are severely injured and for whom reasonable survival is unlikely.)
Category III – Can Wait for Surgery Those who require surgery but no on an urgent basis.

If the operation facility is capable of undergoing surgery for 24 hours, 3192 of mild and 726 cases of severe wounded can receive an operation for first 24 hours. These are 94.5 % of moderate and 100.8 % of severe injured patients.

DISCUSSION

National disaster is exceedingly unpredictable, and health providers have little experience to provide care during sudden increase of patients. This exploratory article is based upon an assumed premise. There is no knowing how many people and how much area will be affected in real situation. The International Committee of the Red Cross (ICRC) has classified casualties into three triage categories in a disaster as Table 2.[2,7] Injured patients that are more likely to recover have priority for medical treatment. They do not have much time for resuscitation in mass casualty situation, therefore cardiopulmonary resuscitation is not recommended except abundant medical support.[8]

Injury Severity Score (ISS) is an anatomic scoring system that ranges from 1 to 75. ISS is derived by using the Abbreviated Injury Score (AIS) that is calculated from six body areas (head/neck, face, thorax, abdomen, extremities, and external) ranged 1 to 6 score respectively.[9] Severe injury is defined as ISS score over 15. Severe injured patients that had

been transferred to Level 1 trauma center directly showed a higher survival rate than via Level 2 or 3.[10] Thus, we planned to transfer severe injured people to university hospital. 121 operation rooms of university hospital near Busan take charge of severely ill patients in this study. Estimated operation time for severe injured is 4 hours, therefore 726 severe cases of surgery can be dealt on emergency basis for first 24 hours. This is 100.8% proportion of 720 severe patients that require emergency operation immediately.

In Bam Earthquake in 2003 in Iran, large numbers of doctors and nurses were wounded and passed away unfortunately. Most of the major hospital and institution was destroyed.[11] The dead reached 4,000 people, and the injured was reported almost 10,000 people. Total 185 survivors were transferred to the University General Hospital in Tehran during first seven days that is approximately 1,000 km (621 miles) from Bam area. In this article, it is assumed that medical provider and transport is not damaged and disaster area is localized in coastal district.

Haeundae beach is located about 20 km from Kori nuclear power plant that has been operated since 1979, and four more atomic reactors are under construction here by 2014. This will result in 28 nuclear reactors in South Korea. If there was a disaster by Tsunami in Haeundae Beach, it can cause a serious damage like Fukushima nuclear accident. Tokyo, is 200 km far from Fukushima. The radiation level of Tokyo was 0.8 μ□□/h (Sievert) on the third day after nuclear accident. Sievert is SI unit that evaluates the biological effects of ionizing radiation quantitatively. It derived from Swedish medical physicist, Rolf Maximilian Sievert. The level of 0.8 μ□□/h exceeded the standard over 16 times.[12] This is external exposure of environmental radiation, and have fallen to an hazardless level within a few days. However, internal radiation from radionuclides can also affect human body.[13] The half-life of Cs-137 is 30 years, and have an influence for a long time. There is no definite epidemiologic research of internal exposure, but susceptible group in obstetrics and pediatrics need to have a particular consideration. Haeundae is about 200 km northwest of Fukuoka, most populous city in Kyushu, Japan. Therefore, the accident in Korea can have a significant effect on neighboring country.

No exact report has been published about damage and rescue in natural disaster. We should learn from experiences of past. In Sri Lanka in 2004 Tsunami, total number of death was 30,920. The missing were 6,020 and the injured were 15,256.[14] It was estimated over 310,000 death in the world: Indonesia, India, Thailand, Somalia, Maldives, Malaysia, Myanmar, Seychelles, Bangladesh, Tanzania, and Kenya.[15] International cooperation is required for overcoming a disaster. Medical providers have to collaborate on rescue, transfer, first aid and surgery in case of disaster.[16] Disaster Medicine needs to be dealt with medical education in public health curriculum.[17]

CONCLUSION

Busan is second large city in Korea, and has much capacity in hospital facility. Moreover, neighboring cities have excellent medical resources. The close collaboration is required to handle a crisis like a tsunami. Military or whole country medical support is helpful to overcome the disaster.

Author Contributions:
Conception and design: Sang Yoon Jeon.
Collection and assembly of data: Ki Hwa Lee, Seung Soo Kim, Jin Soo Kim.
Analysis and interpretation of the data: Jae Wook Jung.
Drafting of the article: Kwang Rae Cho, Hyun Chul Joo.
Critical revision of the article for important intellectual content: Yong Han Kim.
Statistical expertise: Ki Hoon Kim
Final approval and guarantor of the article: Yong Han Kim
Corresponding author email: adonis94@naver.com
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