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Acute Hydrofluoric Acid Mass Exposure : Experience in Teaching Hospitals

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Study/Objective: The study objective is to share the experience of acute hydrofluoric acid mass exposure disaster in Korea, and to understand the response needed.

Background: There are many flat display panel and semiconductor factories in Korea, and hydrofluoric acid is an important chemical to make the panel and semiconductor. We investigated the clinical characteristics and demographics of patients who suffered from hydrofluoric acid chemical injury when mass exposure happens.

Methods: We retrospectively reviewed the medical records of patients who were exposed to hydrofluoric acid in a recent disaster in Korea, and who were seen at the emergency centers and ICUs in the university teaching hospitals. Multiple patients occurrence was included, and single patient occurrence was excluded.

Results: Seventy two patients out of 240 suffered from chemical burns, and the burn injuries of the remaining 168 could not be identified by the medical records - even though chemical exposure exists. A total of 72 hydrofluoric acid chemical injury patients were enrolled during the study period, and their mean age was 34. All the patients were accidentally injured by contact with the material, and none of them ingested the material. Only 28 patients wore appropriate protective equipment, and 24 underwent the water irrigation for more than 10 minutes. The most common exposure area was the hand and forearm. Less than 1% of all of the patients had their Total Body Surface (TBS) exposed to hydrofluoric acid. The mean time interval from calcium gluconate administration to pain relief was 28.6 hours.

Conclusion: When exposed to hydrofluoric acid, it was important to wear protective equipment and undergo massive water irrigation. After treatment, we concluded that administration of calcium gluconate and pain killers was successful in relieving pain. When mass exposure by hydrofluoric acid occurs, the severities of patients are various, and most of the patients were mild cases.

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Strategies to Optimize Performance of Healthcare Workers in Hazmat Incidents

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Study/Objective: To report the strategies that can be adopted to mitigate the challenge of climate/weather on decontamination personnel in the tropics/equatorial region. Data from a pilot study on use of a novel solution will be reported.

Background: Decontamination is a critical process and is an integral part of a medical defence against a hazmat/chemical incident. In an acute onset event, be it unintentional, eg. Industrial release or intentional, eg. terrorist incident, there is an urgent and critical need to establish reliable decontamination facilities both at the incident site and receiving health care facilities. Healthcare facilities face a huge dilemma that some may have to train, maintain competence, and deploy healthcare workers to work in decontamination facilities at the outset, while waiting for reinforcement. Communities in tropical and equatorial climates faces an additional challenge of heat and humidity, which can degrade the ability of workers who have to function and operate in Personal Protective Equipment (PPE).

Methods: A review of strategies and methods used in the past and present to optimize and improve performance of personnel working in decontamination facilities. A pilot study comparing the impact (quantitative and qualitative) of a novel personal body cooling device during a decontamination training exercise will be presented

Results: Strategies include a work rest cycle, formation of organic teams, health screening, and others. Use of novel body cooling device has helped to reduce the physiological impact. This is expected to increase the work cycle and enhance operational efficiency.

Conclusion: A combination of many different strategies can help mitigate the challenge of working in PPE in the tropics and equatorial regions.

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Nanoemulsion for Nuclear and Radiological

Decontamination of Skin

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Study/Objective: Nanoemulsion for skin decontamination of the radio nuclides. Decontamination Efficiency (DE) of the formulation was evaluated on the rat model using the Whole Body Counter. After application on the contaminated skin, there is a significant decrease in the net count of the gamma emitting radiation of the radioisotopes. Skin histopathology was also found to be compatible.

Background: Radioactive contamination can arise from accidents involving nuclear reactors, industrial sources, or medical sources. Uncontrolled chain reaction during nuclear reactor accident or nuclear bomb explosion results in the release of a number of radionuclides, especially the long-lived radioisotopes.

Methods: The Phase Inversion Temperature (PIT) method was employed for the preparation of nanoemulsion. Prepared nanoemulsion was found to be uniformly homogenous and stable. Dynamic Light Scattering (DLS) measurements were carried out using Nano-sizer/Zetasizer ZS (HORIBA La-900, UK). Globule size of the nanoemulsion is in the expected nano-range. The globules of nanoemulsion are in the expected nano-range, as determined by using the Transmission Electron microscope (Morgagni 268D, FEI, Holland). The homogeneous phase of the nanoemulsion was determined by acquiring confocal microscopic images of the Rhodamine 123-treated nanoemulsion with an optical Leitz Confocal microscope (Leica TCS SP2 UV, Wetzlar, Germany) equipped with Coolsnap ES camera (Roper Scientific, Evry, France).

Results: Before and after each decontamination attempt, whole body counts were recorded with NaI(Tl) detectors mounted on chair geometry. The 1,026 channel acquisition time was kept as 10 minutes. A significant decrease in the radioactivity were recorded for ^{99m}Tc , ^{131}I & ^{201}Tl . The results obtained comply with the previously published results.

Conclusion: Developed nanoemulsion could be effectively used for decontamination of the radioisotopes from skin. To remove most of the contaminants, only one to two decontamination attempts are enough. Radioactive waste generation could also be limited. These studies show that the nanoemulsion of p-tertbutylcalix[4]arene could be used as a decontamination formulation against the broad range of radioactive nuclides.

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Let There be Light: Evaluating Decontamination Effectiveness during a Large-scale Simulation of a CBRNe Disaster

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Study/Objective: Evaluate the effectiveness of patient decontamination during a disaster simulation using a visual tool.

Background: Chemical, biological, radiological, nuclear, and explosive (CBRNe) disasters have significant impact on affected populations. Health care workers (HCWs) must be prepared to execute a Disaster Plan in order to mitigate the

negative health outcomes of such events. Decontamination constitutes a major component of disaster response. It optimizes health outcomes by limiting the incidence of secondary, contaminant-mediated injury. Maintaining a "locked down" of the decontaminated care area also reduces the risk of significant injury among exposed HCW and uncontaminated patients. This study proposes an objective assessment of decontamination effectiveness, which lacks in the literature.

Methods: We organized the largest documented pediatric, hospital-wide, disaster simulation with 64 simulated patients and 97 HCW participants. After a brief training, participating HCWs executed the decontamination procedure for the first time. Liquid-based *Glo Germ*TM was randomly applied on different body areas, and recorded in 30 simulated patients. Using an ultraviolet light, two independent raters evaluated the total contaminated body surface area before and after decontamination. Simulated patients triaged as contaminated went through a sequence of undressing, followed by low-pressure, high-volume water and soap washing. Effectiveness of decontamination was calculated using a prepared standardized diagram of body surface area. Inter-rater reliability was assessed with a two-way, mixed consistency, average-measures, intra-class correlation coefficient (ICC) using SPSS.

Results: Undressing followed by washing led to an average 80.6% reduction in total body contamination (95% CI [73.6-87.6]). The ICC was 0.91 (95% CI [0.81-0.96]), indicating that decontamination was evaluated similarly between raters.

Conclusion: A liquid-based visual tool, used as a way to determine decontamination efficacy, is easily obtainable and innovative, and it can help establish verifiable decontamination standards in disaster literature. Undressing followed by washing led to an average 80.6% decrease in total body contamination.

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Preparing a Tertiary Medical Center for a "Dirty-Bomb" Threat

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Study/Objective: To review hospital preparations and drill design, of a tertiary medical center for a "dirty-bomb" scenario.

Background: Terror risk in general, and specifically the risk of terror related to a dirty bomb deployment has increased in recent years. Though the radiation injuries expected to occur in such a scenario are minor, in comparison to the conventional injuries, the psychological impact and the resulting area contamination are expected to be significant. The Israeli Ministry of Health guides and evaluates public hospitals preparedness measures, for a variety of conventional and non-conventional scenarios; these include radiological threats. In April 2016 following 6 months of preparations, a "dirty-bomb" drill was conducted at the Beilinson tertiary medical center.

Methods: Descriptive analysis of the drill design and the preparatory actions.