61. DECONTAMINATION OF CASUALTIES AFTER EXPOSURE TO HARMFUL LIQUID CHEMICALS

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INTRODUCTION

There are considerable risks of chemical accidents in industry and during transport. In addition there has been a growing concern about the possibility of terrorist use of biological or chemical agents. Furthermore by participating in humanitarian, peacekeeping or peace enforcing missions to different countries a number of civilians and military personnel will run the risk of exposure to known or unknown chemicals.

In 1992 the National Board of Health and Welfare (SoS) in Sweden established priority guidelines for measures to protect the medical and health care services against nuclear and chemical warfare agents. The Board also took the initiative to promote thorough discussions on chemical protection in medical care between civilian and military authorities concerned with the matter. These discussions resulted in a report (1) in which measures were suggested for medical personnel at emergency departments, medical teams and ambulance crews to receive personal protective equipment which will afford them at least limited ability to deal with chemically contaminated patients at the accident site, during transport and on admission to a hospital.

In this contribution I will review some projects encouraged and financially supported by the National Board of Health and Welfare and Swedish Agency for Civil Emergency Planning (ÖCB).

FUNCTIONAL ASSESSMENT OF THE DECONTAMINATION UNIT AT THE STOCKHOLM SÖDER HOSPITAL FOLLOWING EXPOSURE TO SIMULATED LIQUID PHASE CONTAMINANTS.

The objective of this study was to evaluate how efficiently volunteers exposed to simulated liquid contaminants could be decontaminated (2). Twenty-four volunteers participated in the experiment. Eight volunteers presented ambulant cases and sixteen on stretchers. They were all fully dressed and all were wearing a protective mask. During the experiment all staff was wearing personal protective equipment including respiratory protection (M90), dress 701 and rubber gloves and boots. The clothes, skin and hair of the volunteers were contaminated with the simulated liquid phase contaminants, ethyl lactate and methyl salicylate. Ethyl lactate is completely water soluble with properties but not toxicity, similar to sarin. Methyl salicylate is poorly soluble in water and not very volatile. It is a nasty-smelling, familiar component of liniment that could cause some local irritation. Sulphur hexafluoride gas was used to confirm the ventilation efficacy. Decontamination followed the guidelines using a two-stage procedure. In the first chamber, all volunteers received a 3-minute shower with water at 30ºC, and their clothes, but not the respiratory masks, were removed. In the second chamber they were twice washed thoroughly with soap and water. After decontamination, the volunteers entered a third chamber for first aid measures. The capacity was 16 volunteers per hour with two thirds on stretchers. The air concentration of sulphur hexafluoride was reduced by 1:10,000 between the first and the third chamber. The levels of ethyl lactate and methyl salicylate measured in the third chamber were low (around $5 \mu g/m^3$). However, after self-decontamination of the staff the concentration of ethyl lactate increased significantly in the third chamber. One explanation to this increased level could be residual ethyl lactate in their underwear (a kind of cotton pajama). This observation revealed a deficiency in the guidelines for self-decontamination.

TO DECONTAMINATE OR NOT TO DECONTAMINATE…?

The scope of this study (3) was to examine whether residual toxic gases from clothes of casualties accidentally exposed to industrial chemicals could be transferred to an ambulance or an emergency ward to such an extent, that ambulance crew and medical personnel could risk becoming chemical casualties themselves. It could be expected that the risk is high for contamination by residual amounts of toxic gases in clothes, if the chemical accident happens in an industrial facility with a limited space. The study should also give information on how these toxic gases were transferred. A fully dressed dummy, warmed to a temperature similar to a living human being, was exposed to ammonia, sulphur dioxide or chlorine at various concentrations (1000, 10,000 100,000 ppm) in a small chamber. After exposure for 15 minutes the dummy was carried to an “emergency ward”, where the levels of evaporating gas were measured. The measurements were made 30 cm above the chest of the dummy, since this distance ought to be a fairly good estimation of the risk zone of medical staff (nurses) for exposure to toxic gases by inhalation. The method was verified for human conditions by exposing one volunteer for the lowest concentration of ammonia (1000 ppm).

The results of this study show that chemical casualties exposed to high concentration of toxic industrial gases could bring concentrations, high enough to harm the medical staff. In extreme cases the medical staff could be so seriously affected that they have to be subject to emergency treatment.

The medical personnel taking care of chemical casualties are recommended to wear respiratory protection before the patients are undressed. In cases when it is obvious that casualties have been exposed to low concentrations of industrial gases there is no need for undressing of the exposed or protective equipment.

PERMANENT FACILITIES AT HOSPITALS FOR DECONTAMINATION OF CHEMICAL CASUALTIES – VALIDATION OF FUNCTION AND ROUTINES

In Sweden, the National Board on Health and Welfare supports the authority responsible for the hospitals, county councils, financially and by expertise to implement a program to establish permanent decontamination units at emergency hospitals. Today about 50% of the emergency hospitals have obtained such facilities. It is estimated that in a couple of years all emergency hospitals will have facilities for decontamination.

The decontamination units at the emergency hospitals differ from the unit at DEMC, Stockholm Söder hospital (SÖS). In this three-chamber unit, decontamination is performed stepwise. It is constructed for high capacity and security and for decontamination of casualties exposed to highly toxic agents in peacetime and during war conditions.

The decontamination facilities at the majority of emergency hospitals are designed not only for accidents with chemicals but also for substances giving ionizing radiation under peacetime conditions. They should also be safe enough to allow decontamination of casualties contaminated with small amounts of highly toxic chemicals, i.e. chemical warfare agents (CWA) without causing serious hazards for medical personnel, patients or various other functions at the hospital. The facilities are built for security and low capacity and are suitable for daily cleaning purposes.

The decontamination of chemical casualties near the accident scene is of major importance, while the decontamination unit at the hospital chiefly should fulfil the need to decontaminate contaminated chemical casualties appearing spontaneously at the hospital. The capacity and routines of the decontamination units at the emergency hospital are dimensioned for decontamination of a limited number of casualties simultaneously. However, the hospital will have to decontaminate and take care of a large number of casualties. This situation will of course put a heavy burden on the hospital.

There is also a need for education and training of the medical personnel at the emergency hospitals, who are tasked with the decontamination. The education and training available today are usually either based on decontamination in the field or decontamination in the advanced three-chamber unit of Stockholm Söder hospital.

Roughly described, the facilities at the emergency hospitals usually consist of a decontamination room, a lock and an ambulance hall. However, there are differences between the various hospitals. It therefore appeared important to validate the function and routines at least in some of the decontamination facilities to try to make them optimal for the facility. It is also important to give the medical personnel instructions, education and training adapted to the facility in which they will perform the decontamination of chemical casualties.

The National Board of Health and Welfare therefore took the initiative to a study of the function and the routines of the decontamination facilities. Of the units selected, two were located in emergency hospitals and one in an outpatient care center. One facility was situated in the south of Sweden; the other two were in the north. The selection was made so that the selected facilities were representative of the facilities built in Sweden. The studies were designed to answer some important questions, for instance: How dangerous is it to get significant amounts of highly toxic agents into the facility? How high is the risk for unintentional distribution of chemicals from the decontamination facility to other rooms of the hospital? When, after completed decontamination, can the decontamination facility be considered clean?

The selected facilities were studied during both summer and winter conditions. The design of the study was similar to the study of the decontamination facility at the Stockholm Söder hospital but a great number of new parameters were measured. Before performing experiments with human volunteers, the function of the facilities was studied. Ventilation, water supply, drainage, and control systems were among the parameters studied. Technical shortcomings were taken care of when possible.

Before the experiment the medical personnel tasked with the decontamination obtained education and training on the protective equipment. In the experiment the volunteers, usually in groups of 3 or 4, were exposed to the simulated liquid phase contaminants ethyl lactate and methyl salicylate. They were then taken into the decontamination room and decontaminated with soap and water and taken through the lock and the ambulance hall into the hospital (or ward). The levels of the contaminants in the air of different rooms were continuously monitored or sampled at intervals for analyses. A vast number of other parameters were also measured. The results of this study are now being compiled in a final report. It can be safely concluded that the facilities studied, with some changes in instruction and routines, are functioning well both during summer and wintertime. The medical personnel have obtained education and valuable training under realistic conditions. Furthermore, valuable information has been obtained for preparing guidelines for the facilities built and to consider seriously, when building new facilities. The result should also be of value in the education and training of medical personnel.

GENERAL CONCLUSIONS

Some of the efforts made in Sweden to increase the protection of the hospital against chemical accidents and chemical warfare by improving the ability of the Medical and Health Care to handle Chemical casualties and to increase its protection against chemical contamination have been reviewed

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