Development of a New Confined Space Model

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Abstract

Confined space medicine is one of the most important training for urban search and rescue. However, the construction of a confined space for training is usually time- and cost-consuming. To construct a virtual confined space, we utilized the materials available at hand such as 30 to 50 long tables, 60 paper boxes, 20 large curtains, 4 Manikins for resuscitation and intubation, 1 pack of flour, 5 rolls of sealing tapes and 1 make-up box in six training courses in 2002. We designed a questionnaire to evaluate the reality, difficulty, safety, creativity, and applicability of the model. The time elapse for constructing the virtual confined space was in average 45±5 min and that for cleaning up 25±5 min. The average cost for setting up the tunnel was 950±80 NSD. Of 432 questionnaires, the average scores for 5 items were 7.8±1.4 for reality, 6.5±1.8 for difficulty, 9.0±0.6 for safety, 9.3±1.1 for creativity, and 9.0±0.8 for applicability. For the items of applicability, the subheadings of adequacy for practicing BTLS, definitive care, communication, and full evaluation were obtained 9.4±1.4, 9.3±1.2, 8.6±1.4 and 8.3±1.5, respectively ($P<0.05$ by ANOVA). In conclusion, we create a simple model of virtual confined space that will be of help in the comparable training courses. *(Ann Disaster Med. 2003;2:1-6)*

Key words: Confined Space Medicine; USAR; Virtual Model; Disaster Medicine

Introduction

A confined space is any space large enough to access, but has limited entry and is unsuitable for continuous employee occupancy.[1,2] Confined spaces usually contain the potential safety hazards such as physical, chemical, or atmospheric injury.[3] In additional, it deserves specific training for the rescuers to operate any measures and procedures in the limited space in a time-efficient manner.[4] In the United States, Occupational Safety and Health Administration (OSHA) has implemented many guidelines for confined space rescue.[5] We also think it is essential for us to have adequate confined space rescue training in the viewpoint of disaster medicine.

Without proper training, confined space rescue becomes a game of chance. OSHA studies demonstrated that hundreds of people have miscalculated their chance for survival in confined space operations.[5] The objective for the rescuer is to recognize when the odds are stacked against them, and then to implement a change in the operation to increase the margin

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Received: April 3 2003. Revised: April 20 2003. Accepted: May 18 2003.
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This study was under the grant of Department of Health, DOH91-TD-1143

of safety, or stack the odds in their favor.

However, most of the training sites for confined space rescue in the United Sates contain training tower, trench rescue and water tower rescue. They provide good virtual circumstances for the students to operate under standard procedures.[3] However, the buildings and equipments are space-occupying and need good financial support. It may become a barrier for us to generalize the training program in Taiwan. We then developed a simplified model of confined space which mimics the real circumstances but is cost-effective.

Methods

Designing the simple model of confined space

To construct a virtual confined space, we utilized the materials available at hand such as 30 to 50 long tables, 60 paper boxes, 20 large curtains, 4 Manikins for resuscitation and intubation, 1 pack of flour, 5 rolls of sealing tapes and 1 make-up box.

The steps of construction were as follows:

1. Align the long tables face to face to form a tunnel with different bending angle, height and width along the whole pathway. The basic height of the tunnel was about 50 to 60 cm and the width less than 80 cm.
2. Place the manikins in different areas along the tunnel, at least 5m apart each other. Each manikin was arranged with different orientation.
3. Cover the tunnel with paper boxes and seal with tapes.
4. Put some flour or powder to mimic the dusts that could be found in the confined space.
5. Cover the tunnel externally with the curtains or sheets to make the tunnel poorly illuminated.
6. Pre-set one end of the tunnel as the entry and the other the exit.

The time elapse for constructing the virtual confined space was recorded and averaged.

Evaluation of the efficiency and safety of the model

To evaluate the efficiency of the model, we designed a questionnaire to analyze the opinions of the students during disaster medical assistance team (DMAT) training courses from January 2002 to December 2002. The questionnaire was composed of 5 vision scales (scoring from 0 to 10) for the following items: reality, difficulty, safety, creativity, and applicability. Under the item of applicability, the student was asked to evaluate the adequacy of practicing standard basic trauma life support (BTLS), adaptation of definite care, communication and full evaluation within the tunnel. The scores were recorded and averaged.

Statistical analysis

The categorical data were inputted in Microsoft Excel 2000 for descriptive statistics and further qualitative analysis. ANOVA with a Newman-Keuls post hoc test was used to determine whether any significant differences existed among continuous data. A $P < 0.05$ was considered to be statistically significant.

Results

The data obtained from six DMAT training courses were enrolled for analysis. The time elapse for constructing the virtual confined space was in average 45 ± 5 min and that for cleaning up 25 ± 5 min. The average cost for setting up the tunnel was 950±80 NSD.

There were 432 students who attended DMAT training course and completed questionnaire. Three hundreds and twenty-eight of them were nursing staffs, 44 physicians and 60 staffs of logistics or administrative. The average scores for 5 items were 7.8±1.4 for reality, 6.5±1.8 for difficulty, 9.0±0.6 for safety, 9.3±1.1 for creativity, and 9.0±0.8 for applicability. No definite injury was documented during six training courses.

For the items of applicability, the subheadings of adequacy for practicing BTLS, definitive care, communication, and full evaluation were obtained 9.4±1.4, 9.3±1.2, 8.6±1.4 and 8.3±1.5, respectively (Figure). The latter two were significantly lower than the former two (P <0.05 by ANOVA).

P<0.05

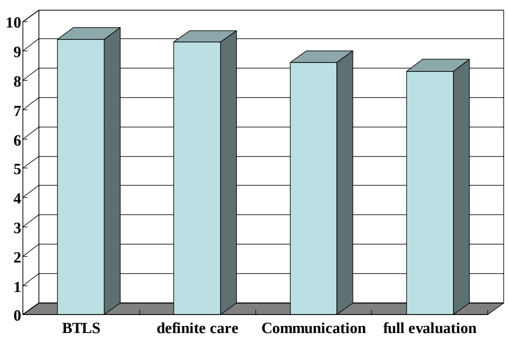

Figure. Scorings for four subheadings of the item applicability

Discussion

According to past experience, most disaster victims received search and rescue from their neighbors, family, friends or the person who happen to be at the disaster scene. Few victims are able to get prehospital care from doctors or nursing staff due to hospital itself is a disaster victim.[6-9] Immediately after the occurrence of disaster most of the staff in hospital has to manage their institute. It is unrealistic to expect the help from hospital staff for an external disaster at the first minute. In this study, we set up the standard procedure as well as the simulated model of urban search and rescue (USAR) in a confined space. We successfully complete the provider manual as well as instructor manual of USAR in a confined space. The publications can be used as a guideline in that kind of scenario.

It is believed that the understanding of the unique environment and knowledge of confined space medicine will enhance the survival of and reduce morbidity in the extricated patient. Approach and treatment needs to begin as soon as possible to maximize the chances of survival. The chance of extricating a live victim drops usually dramatically after 24 hours following the building collapse. Many past experiences supported the concept.[13-15]

Confined space rescue involves mainly USAR and partially disaster medical assistant teams.[3,5] USAR is one of the emergency support functions according to the design of the United States. Personnel assigned to task forces of their USAR Response System are highly trained and possess specialized expertise and equipment. Under their incident command systems, so-called emergency support function #9 addresses only US&R instead of all other forms of search and rescue (e.g., water, wilderness, subterranean) that are managed under different authorities.[3] To fulfill the requests that rapid activation to complete rescue within 72 golden hours and response for any incident or anticipated incident likely to result in overwhelming collapsed structures, their training include incident support, structural collapse technique, medical support and logistic support. In the context of their medical specialist training, confined space medicine is an important issue.[3,10-12] Although a throughout confined space medicine training include rescuer's safety, atmospheric monitoring and stabilization of the victims, a virtual confined space is essential for such a training course.

To our knowledge, a virtual confined space includes the scene of training tower, trench and water tower.[5] According to the past experience of Fire Service Administration, it still cost about 200 thousands NSDs even though only a simply confined space was temporarily constructed. Besides, the safety of the students might be another problem. Because of limitation of space and cost, we developed a model of confined space for training that could fulfill most of the skills that should be involved. The design costs less than one thousand NSDs and is safe for each participant. The model has the characteristics of a confined space including limited entry and exist, narrow space, poor ventilation, poor illumination and unstable infrastructure. The cost-effectiveness and safety guarantying of the model provides a good way for generalization of confined space training.

The limitations of the model for confined space medicine were as follows. First, as the data revealed, the model could not provide adequate training of communication and full evaluation because of the use of the manikins at the scene. Further modification with volunteer instead at the scene may increase the likelihood of confined space rescue. How to apply some noise-proof appliances over the tunnel should also be considered in the future. Second, the tunnel mimicked mainly the condition of the trench, but could not simulate well the conditions of training towers. In other words, our model could not afford the operations in the descending of a vertical hole. The same problem was also met in the situations of water towers.

In conclusion, we create a simple model of virtual confined space that will be of help in the comparable training courses.

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