Nurse Education Today 62 (2018) 52–57

Contents lists available at ScienceDirect

Nurse Education Today

journal homepage: www.elsevier.com/locate/nedt

Analysis of performance and stress caused by a simulation of a mass casualty incident

Antonio Nieto Fernández-Pacheco[a,f], Rafael Castro Delgado[b], Pedro Arcos González[b], José Luis Navarro Fernández[c], José Joaquín Cerón Madrigal[d], Laura Juguera Rodriguez[a,c], Nuria Perez Alonso[a,f], David Armero-Barranco[e], María Lidon López Iborra[e], Escribano Tortosa Damian[g], Manuel Pardo Rios[a,f,*]

[a] Faculty of Nursing of the Catholic University of Murcia (UCAM), Spain
[b] SAMU-Asturias. Servicio de Salud del Principado de Asturias, University of Oviedo, Emergency and Disaster Unit, Spain
[c] University Clincal Hospital of Murcia (HUVA), Spain
[d] Interdisciplinary Laboratory at University of Murcia (UM), Spain
[e] Faculty of Nursing at University of Murcia (UM), Spain
[f] Emergency Services 061 (112) of Murcia, Spain
[g] Department of Food and Animal Science, School of Veterinary Medicine, Universitat Autònoma de Barcelona, Spain

ARTICLE INFO

Keywords:
Emergency medical services
Stress
Mass casualty incident
Simulation
Training

ABSTRACT

Objective: To determine the stress that is potentially produced in professional health workers due to a mass casualty incident (MCI) simulated exercise, and its relation to prior academic training and the role played in the simulation.

Methods: Observational study of stress in a MCI. For this work, two MCI drills comprised of 40 victims each were conducted. Two randomized groups of 36 students each were created: Master's Students Group (MSG) and Undergraduate Student Group (USG). The role performed by each student (triage or sectorization) was assessed. The stress level was determined by prior and subsequent measurements of alpha-amylase (αA), HR, SBP and DBP.

Results: The percentage of victims that were correctly triaged was 88.6%, 91.84% for MSG and 83.76% for the USG ($p = 0.004$). The basal αA was 97,107.50 ± 72,182.67 IU/L and the subsequent αA was 136,195.55 ± 90,176.46 ± IU/L ($p < 0.001$). The baseline HR was 78.74 ± 14.92 beats/min and the subsequent HR was 95.65 ± 23.59 beats/min ($p = 0.000$). We found significant differences in the αA between students who performed the triage and those who performed sectorization but there were no differences between undergraduate and Masters' students.

Conclusion: Conducting a simulated exercise caused stress in personnel involved in the MCI, with a greater impact on participants who performed triage, although it was not influenced by their prior academic level. The stress level in our case did not affect or determine the performance of acquired skills.

1. Introduction

Mass casualty incidents (MCI) are defined by the World Health Organization (WHO) as “events which generate more patients at one time than locally available resources can manage using routine procedures” (World Health Organization, 2007). Although these types of events are more frequently than believed (Castro Delgado et al., 2016), a health professional has to use their knowledge and practical skills under a high-pressure situation in order to provide the correct health care (Cuartas Álvarez and Castro Delgado, 2009). Among the main processes to consider, we find triage, defined as “classification of patients into different categories according to their severity and prognosis in order to determine their priority for care and evacuation” (Castro Delgado et al., 2015).

Training of health professionals not only requires the transmission of knowledge and skills, but their training has to be conducted in

* Corresponding author at: Faculty of Nursing of the Catholic University of Murcia (UCAM), Campus de los Jerónimos, Guadalupe (30107), Murcia, Spain
E-mail addresses: anfpacheco@ucam.edu (A. Nieto Fernández-Pacheco), castrorafael@uniovi.es (R. Castro Delgado), arcos@uniovi.es (P. Arcos González), JLNF@ono.com (J.L. Navarro Fernández), jjceron@um.es (J.J. Cerón Madrigal), ljuguera@ucam.edu (L. Juguera Rodriguez), nperez@ucam.edu (N. Perez Alonso), darmero@um.es (D. Armero-Barranco), lidon@um.es (M. Lidon López Iborra), mpardo@ucam.edu (M. Pardo Rios).

https://doi.org/10.1016/j.nedt.2017.12.016
Received 16 May 2017; Received in revised form 13 November 2017; Accepted 8 December 2017

environments that are as similar as possible to real situations (Kaddoura, 2010). Training in these kinds of environments implies the creation of stress for the student (Maran and Glavin, 2003), which is necessary so that the student acquires confidence in their ability to apply their knowledge in real-life situations. This stress has been measured in different studies (Karasch et al., 2011), mainly related to the application of specific techniques on individual patients (Ignacio et al., 2016), but studies on the capacity of a MCI simulation to generate stress on the student has not been conducted, and how this stress is related to the learning process has not been studied either.

A research study by Fernández-Castillo and Gutiérrez Rojas, 2009, concluded that students who obtained a high score in their degree of anxiety also had low levels of selective attention (Fernández-Castillo and Gutiérrez Rojas, 2009). However, another study by Oblitas, 2004 concluded that subjects who had a high degree of anxiety usually focused more on their own thoughts and fears than the exam task at hand (Oblitas, 2004). The results obtained from a study on stress and student assessment did not find a clear relationship between their anxiety and academic performance (Álvarez et al., 2012). In summary, the studies coincided in that a certain degree of anxiety was desirable, and was needed for performing tasks that were important for the subjects. However, high levels of anxiety made difficult the execution of a task, resulting in overall low performance. Psychosocial stress induces various adaptation responses of physiologic systems with particular increasing activities in the hypothalamus-pituitary-adrenal axis (HPA) as well as in the sympathetic-adrenal-medullary (SAM) system. Many studies have shown that salivary alpha amylase could be used as a better index of acute stress than cortisol, with a longer latency time (Vineetha et al., 2014; Valentin et al., 2015).

The hypothesis of this study is that health professionals who perform triage in simulations experience physiological changes with a concomitant increase of stress. The main object of this study was to determine the level of stress that was potentially produced on participating personnel during and by a simulation exercise that recreates a mass casualty incident. The more specific objectives were to analyze individual variables associated to the level of stress, to establish if there was a relationship between the level of stress and the prior academic level of the intervening individual and/or his/her role in the simulation, in order to determine if the level of stress had an influence on their capacity to use their acquired abilities. As amylase is a biological marker of stress, it was also decided that another specific objective would be to analyze the relationship between concentration of amylase and the rest of the physiological indicators, such as blood pressure (BP) and heart rate (HR).

2. Materials and Methods

An observational study on the stress that is potentially produced by a MCI simulation was conducted, within the Sectoral Health Plan as part of the Territorial Plan of Civil Protection of the Region of Murcia (PLATEMUR), with the collaboration of the Catholic University of Murcia (UCAM) and the University of Murcia (UMU). The research project was approved by the Ethics Committee at the Management of Urgencies and Emergencies 061 of the Region of Murcia (GUERM-061). All the participants (victims or health workers) participated voluntarily, signing a consent form to that respect.

For this work, 2 MCI simulations were conducted, comprised of 40 victims each (10 green, 17 yellow, 10 red and 3 black). The objective of the health professionals was to conduct a search for victims, their triage and sectorization (Fig. 1). The triage system used was START (Simple Triage and Rapid Treatment), which required the use of the following emergency techniques: opening an airway (OAA), which had to be performed in 15% (6/40) of the cases, and hemorrhage compression (HC) in 12.5% (5/40) of the cases. The correct performing of triage and the emergency techniques were assessed by 3 health professionals (all instructors in Advanced Prehospital Trauma Life Support and experts in triage and MCI) from the GUERM-061.

2.1. Sample Selection

For each of the simulations, the allocation of roles (triage or sectorization and treatment) were randomly assigned to each of the students from each of the study groups created (comprised of 34 students each), which were: Master's Students Group (MSG), comprised by the students enrolled in the Master's program of Emergency and Special Care Nursing at the UCAM (class of 2015–2016), and another Undergraduate Student Group (USG), comprised by 3rd year students enrolled in the Nursing Degree at the University of Murcia, who were enrolled in the Critical Care course. All the participants received the same training prior to the conducting of the simulation. The training consisted of theoretical classroom training for 2 h and the resolution of clinical cases for another 2 h. An instructor in Advanced Prehospital Trauma Life Support and expert in triage and MCI conducted this training.

2.2. Measurement of Stress and Activation

The basal (αAB) and subsequent (αAS) levels of the α-amylase enzyme were measured in all the participants through a passive diffusion system by collecting saliva into a tube, with an extraction time of 1 min. The αA was measured with a commercial kit (Olympus®) and the protocol used was the one recommended by the International Federation of Clinical Chemistry and Laboratory Medicine (IFCCLM). The assay was adapted to an automatic analyzer (Olympus AU400®). The method produced an inter-assay Coefficient of Variation (CV) of 3% and a linear regression coefficient of 0.992.

2.3. Statistical Analysis

The following variables were recorded for all the participants: age, weight, height, Body Mass Index (BMI = weight in kilograms/height; Castro Delgado et al., 2016), weekly physical activity, medical antecedents of interest (MAI), dental problems, presence or not of plaque, gingivitis, medication, use of vitamins and/or antioxidants, smoker or not and the timing of the last meal. The other variables analyzed in this study were: mean number of triaged victims, mean number of victims that were correctly triaged, correct performing of OAA, correct measuring of HC. The main variable (MV) of the study was the increase in concentration of α-amylase (IαA), which was determined with the following formula: IαA = αAB-αAS. Also, the HR and BP were determined, with this last divided into BP-Systolic (BPS) and BP-Diastolic (BPD).

The data are presented using frequency, mean and standard deviation. For comparing the results between the two study groups, the Wilcoxon rank test (W) was used for those cases where normality in the data was not found, and the Student's *t*-test (*t*) for those cases where normality was found. For the cases of number of victims found, well-triaged victims, victims whose airways were opened, and victims who experienced hemorrhage compression, a Chi-square test with the Yates correction was applied, as these were nominal variables. All the statistical results were obtained through the statistical package SPSS® v21. The results were considered to be statistically-significant if $p < 0.05$.

3. Results

The average age of the participants was 26.00 ± 6.61 (27.11 ± 7.75 for the MSG and 24.89 ± 5.09 for the USG), with a mean weight of 66.75 ± 14.48 (66.11 ± 14.68 for the MSG and 67.44 ± 18.28 for the USG), height of 1.69 ± 0.09 m (1.68 ± 0.85 for the MSG and 1.69 ± 0.09 for the USG), with a BMI of 22.93 ± 3.67 (22.79 for the MSG and 23.06 ± 4.37 for the USG). The mean physical activity that the volunteers said to perform was 3.97 ± 3.73 h/week (3.81 ± 2.97 for MSG and 4.14 ± 4.39 for USG). Between the two groups (MSG and USG), no significant