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Doctoral dissertation: EVALUATION OF SELECTED CARDIOPULMONARY RESUSCITATION TECHNIQUES OF A PERSON WITH SUSPECTED INFECTIOUS DISEASE BY MEDICAL PERSONNEL EQUIPPED WITH PROTECTIVE SUITS UNDER MEDICAL SIMULATION CONDITIONS

Summary

Introduction

Cardiopulmonary resuscitation is a complex process, which includes both chest compression, airway management, and effective ventilation, as well as obtaining vascular access and pharmacotherapy. According to the guidelines of the European Resuscitation Council (ERC) as well as the American Heart Association, high quality chest compression is a key factor in increasing the chances of the return of spontaneous circulation. The current coronavirus SARS-SoV-2 pandemic forced medical personnel - including, in particular, the staff of the National Emergency Medical System teams - to perform medical procedures on patients with suspected/confirmed infections using personal protective suits. However, as numerous studies indicate, the use of these suits may reduce the quality of the procedures performed as well as increase the time of their performance.

Aim of the study

The common aim of the series of studies included in a series of thematically coherent publications was to compare different techniques of cardiopulmonary resuscitation of a person with the suspected infectious disease by medical personnel equipped with protective suits under medical simulation conditions.

Material and Method

Three studies included in the publication cycle were conducted under the conditions of simulation of cardiopulmonary resuscitation of an adult. All studies were designed as

prospective, observational, randomized, cross-over studies and were based on medical simulation. In all studies for statistical analysis, the results were blinded.

In the first study to compare chest compressions using the LUCAS3 mechanical chest compression system, the CPRMeter 2 CPR feedback device, and the manual chest compression, 35 medical students were asked to perform a 2-min continuous chest compression cycle. Due to the simulation of an infectious patient, the participants wore full CBRN (ProChem I F suit), FFP2 class masks, safety goggles, visor and double nitrile gloves during CPR.

In the second study, which is a continuation of the first one, 67 paramedics were tasked with conducting 2-minute chest compression cycles of an adult. An adult SimMan 3G simulator was used to simulate an infectious patient with cardiac arrest. Participants performed asynchronous chest compression cycles based on the AHA 2015 guidelines for cardiopulmonary resuscitation. Chest compressions were performed using three techniques: a) LUCAS3 mechanical chest compression system; b) TrueCPR2 assistant chest compression system; c) manual chest compression. During chest compressions, participants were dressed, as in the first study, in CPRN protective suits.

Both the first and second studies were multi-center studies.

In the third study 37 paramedics dressed in CBRN class C suits performed 2-minute chest compression cycles of an adult. Chest compressions were performed asynchronously and were performed in two study scenarios: a) compression when the rescuer is on the side of the patient; b) compression when the rescuer is behind the patient's head. Both the order of participants and the chest compression techniques were random.

Results

In the first study to compare the chest compressions performed by medical students in a scenario of unassisted chest compression and using the CPRMeter and LUCAS3 compression system. The depth of chest compressions using the compression methods studied varied and was 40 (IQR; 38-45) mm for unassisted chest compressions, 45 (interquartile range, IQR; 40-50)mm for CPRMeter, and 51 (IQR; 50-52)mm for LUCAS3. The median chest compression rate was also varied and amounted: 109 (IQR; 102-131), 107 (IQR; 105-127), and 102 (IQR; 101-102) compressions per minute respectively. The highest chest relaxation rate was observed

for LUCAS3 and was 100% (IQR; 95-100), followed by 80% (IQR; 60-90) for CPRMeter and 29% (IQR; 26-48) for non-assisted (manual) compression.

In a second study comparing the quality of chest compressions using LUCAS3, TrueCPR2, and non-instrumented (manual) chest compressions, the depth of compressions varied and was accordingly: 51mm (IQR; 50-55), 47mm (IQR; 43-52) and 43mm (IQR; 38-46) respectively. The chest compression rate was 102 (IQR 100-102) compressions per minute for LUCAS3, 105 (IQR; 98-114) for TrueCPR, and 116 (IQR; 112-129) for non-assisted chest compressions. The rate of chest relaxation was highest at 100% (IQR; 98-100) for LUCAS3, 83% (IQR; 60-92) for TrueCPR, and 39% (IQR; 25-50) for unassisted chest compressions. In the third study assessing the quality of chest compressions depending on the position of the rescuer at the patient's side, the depth of the chest compression during the patient's side position was 42 ± 2 mm and was statistically significantly lower than the 46 ± 4 mm behind the patient's head. The rate of chest compressions using these two techniques varied and was 114.5 ± 8 and 107 ± 7 compressions per minute respectively. Higher chest compressions were achieved with lateral position (42 ± 6%) than behind the head (34 ± 10%).

Conclusions

Simulation studies indicate that in the case of cardiopulmonary resuscitation of a person with suspected/confirmed infectious disease, medical personnel wearing CBRN personal protective suits should use mechanical chest compression systems to optimize the quality of chest compressions. Instrumentless (manual) chest compressions carried out by medical personnel in CBRN suits from behind the patient's head generates a greater compression depth than when the rescuer is in a patient's side position.

The effectiveness of instrumentless (manual) chest compressions, while the rescuer is wearing a CBRN suit, decreases after the first minute of compression, so it is reasonable to consider changing the rate of the person performing the chest compressions.