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ORIGINAL RESEARCH

Prehospital Emergency Medicine at the Beach: What Is the Effect of Fins and Rescue Tubes in Lifesaving and Cardiopulmonary Resuscitation After Rescue?

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Objective.—To analyze the influence of fins and rescue tube use in a water rescue, assessed by time and distance to salvage position, physiological parameters, and cardiopulmonary resuscitation (CPR).

Methods.—Twenty professional lifeguards (10 men, 10 women) conducted 3 tests: a baseline test of 5 minutes of CPR and 2 water rescues, 1 without rescue equipment (NRE), and the other with fins and rescue tube (FRT). They also had to perform 5 minutes of CPR after each rescue. Time and distance of the rescues, physiological parameters (blood lactate concentration and heart rate), and quality of CPR were analyzed.

Results.—CPR quality worsened by 26 to 28% ($P < .001$) after rescue. However, there were no differences using FRT. The use of rescue equipment reduced the time (FRT: 216±57 seconds; NRE: 319±127 seconds; $P < .001$) and distance covered (FRT: 265±52 m; NRE: 326±41 m; $P < .001$). No differences were found in lactate levels between FRT and NRE just after the rescues, but there were some after 5 minutes of subsequent CPR (FRT: 10.7±2.2 mmol/L; NRE: 12.6±1.8 mmol/L; $P < .001$). Comparing women with men, we found significant differences in lactate concentrations only in FRT (women: 9.6±1.4 mmol/L; men: 8.1±1.2 mmol/L; $P = .031$).

Conclusions.—The use of fins and rescue tube provides a comprehensive benefit in an aquatic emergency. However, FRT did not have any effect on the quality of the postrescue CPR.

Keywords: water rescue, cardiopulmonary resuscitation, lifesaving equipment, drowning, lifeguard, blood lactate

Introduction

Lifeguards are professionals responsible for the prevention and rescue of drowning victims. Drowning is considered a public health issue by the World Health Organization (WHO).[1] Approximately 0.7% of all the deaths worldwide are due to unintentional drowning.[2] This means more than 1000 deaths each day all over the world. Alcohol consumption in or around aquatic environments,[3,4] sex—since males are twice as likely to drown as females,[5] and self-reported swimming competency[6] are considered drowning risk factors. Immersion and submersion are 2 different events related to drowning whose precursors are cooling of skin, superficial nerves, muscles in the limbs, and deep body tissues. Hypothermia, aspiration, and swallowing water are determining factors in clinical status. In severe

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hypothermia, the person will become unconscious quickly, and aspiration and swallowing will cause systemic hypoxemia, which is life-threatening.[7] In this case, the risk of neurological damage is similar to that in other instances of cardiac arrest, so the person should be taken as quickly as possible to dry land.[2] To prevent the morbidity and mortality from drowning, the rescuer must swim to the victim, provide flotation, prevent further submersion, and get the victim out of the water, as morbidity from drowning may occur in a few minutes and a swift response is vital.[2]

The intervention to rescue a drowning victim requires a specific preparation in special conditions. Lifeguards spend much of their time looking out to sea (surveillance), but with the occasional requirement to move to high-intensity activity and casualty handling in a compressed period of time (aquatic rescue).[8] In the case of an aquatic rescue, lifeguards have to decide which rescue equipment they should use. It has been suggested that the material that combines propelling and/or floating in equipment makes the rescue of victims safer, faster, and more efficient.[9–13] This can be obtained with 1 component, for example a surfboard, rescue tube, or torpedo buoy.[9] Or, through a combination of propulsion fins and a floating device (such as a rescue tube or torpedo buoy).[10,11] However, evidence regarding which equipment's use is more beneficial is anecdotal, and there is little information on which variables are more advantageous to minimize time of rescuing the victim.[12]

The objective of this research is to compare the use of rescue material against the use of no rescue material for both objective and subjective measures of cardiopulmonary resuscitation (CPR), and to reduce performance and physiologic strain in a manikin-based simulation of a lifeguard water rescue.

Materials and Methods

SAMPLE

A convenience sampling was used, and 20 professional lifeguards took part in this study. Participants were recruited by email, and written and oral consent were obtained. Their participation was voluntary and with no remuneration for collaborating. All lifeguards were trained in the European Resuscitation Council Guidelines for Resuscitation (ERCGR 2010).[14] The project was approved by the Ethics Committee of the Faculty of Education and Sport Sciences of the University of Vigo (Spain).

STUDY DESIGN

A quasi-experimental design was used in the evaluation of this crossover study. Variables were grouped in 3 objective categories (quality of CPR, rescue performance, and rescuer's physiological load) and 1 subjective category (perception of effort).

Firstly, descriptive information concerning sex, age, weight, height, as well as body mass index (BMI), was recorded. The subjects then carried out 3 tests (Figure 1).

The first test consisted of performing a 5-minute simulated manikin resuscitation according to ERCGR 2010.[14] Participants were rested at the time of the beginning of this test.

The second and the third test evaluated 2 common lifesaving situations: swimming rescue without auxiliary materials (no rescue equipment [NRE]) and with auxiliary rescue equipment composed of fins and water rescue tube (FRT). The rescues were carried out in 2 consecutive days to avoid the effect of fatigue and provide very similar environmental and sea conditions. In order to prevent learning effect, the order of the lifesaving was randomized for each participant with a random number generator.

CARDIOPULMONARY RESUSCITATION TEST

Each lifeguard conducted 3 CPR tests: a 5-minute baseline test, and the same test at the end of each rescue (30 compressions: 2 rescue breaths). The test was carried out in the laboratories of the Faculty of Physical Education and Sport Sciences of the University of A Coruña. The second and the third CPR tests were conducted after each rescue at the beach.

Resuscitation parameters were evaluated with Laerdal Resusci Anne manikin (Stavanger, Norway) with the Laerdal PC SkillReporting software 2010 Resuscitation Guidelines. This model records the quality of compressions and rescue breaths, differentiating whether they are correct or not. The manikin checks the depth (correct: 50–60 mm), rate (correct: 100–120 compressions per minute), chest recoil, and hands position. For rescue breaths, a 500 to 600 mL tidal volume was considered correct. No feedback was permitted during the test, and compressions and rescue breaths were considered correct when there were no errors.

The cardiopulmonary variables were: chest compression rate (CCR) in compression/minutes, quality of chest compression (QCCp) as a percentage, quality of ventilations (QVp) as a percentage, and overall quality resuscitation percentage: $QCPR = [(QCCp+QVp)/2]$.

LIFESAVING TEST

A standard lifesaving test[10,15] was carried out consisting of: a 50-meter sand run, starting at the watch tower; a round-trip swim (75 m swimming and 75 m back,