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Research article

Design and validation of a tool for the evaluation of the quality of Cardiopulmonary Resuscitation: SIEVCA-CPR 2.0®

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ABSTRACT

Introduction: Currently, no system completely evaluates the quality of cardio pulmonary resusciation.
Methods: A cross-sectional, prospective, longitudinal study using Delphi methodology was performed in three phases: preparatory, consultation and consensus. The validation was made by a prospective longitudinal study using the tool in the evaluation of 11 videos to determine the intra-class correlation coefficient (ICC) and the intra-subject (ICC-Initial), the latter repeated at four weeks (ICC-Final). We have determined intra-subject ICC: Initial-Final. This last result has been compared with a gold-standard value.
Results: After the first phase, a 28-items list has been developed. In the second phase: ICC-Initial = 0.727 ($p < .001$), 95% CI (0.625, 0.801), ICC-Final = 0.860 ($p < .001$), 95% CI (0.807; 0.898) and ICC Initial-Final = 0.880 ($p < .001$), 95% CI (0.835; 0.913). Finally, an online tool has been developed (SIEVCA 2.0).
Conclusion: The designed tool presents good reliability in the assessment of cardio pulmonary resuscitation and it is useful in different fields and scenarios.

Implications for Clinical Practice

- The teaching of the possibility of evaluation of practical knowledge is fundamental to strengthen and check that it has been learned correctly. A tool does not exist that globally values care quality during CPR.
- Is the first tool that addresses the valuation of the CPR in a global way and not only centered on compressions.
- The validity of the tool is good, which allows it to be used by different professionals.
- Through this system you can evaluate the quality of the CPR, whether it is in the ambit of care, education or research, including technical and non-technical skills.
- This tool could be useful in intensive care units to improve team coordination during training, when the team does a reassessment after a CPR happened in the unit.

Introduction

Cardio Pulmonary Arrest (CPA) is one of the leading causes of death in Europe (Nolan et al., 2015), with an incidence of out-of-hospital cardio pulmonary resuscitation (CPR) in Spain of more than 50,000 cases per year; less than 10% of the cases of CPR survive without neurological seqaulae (Gazmuri and Alvarez-Fernández, 2009).

In recent years, efforts to improve the knowledge of cardiopulmonary resuscitation (CPR) have been quite remarkable, but despite this progress, a high percentage of mortality is still present, so it might be advisable to disseminate basic CPR more widely. Theoretical training is not enough, other aspects must also be taken into account such as practice skills and some non-technical skills (e.g. communication, leadership, roles, etc.) (Paglialonga et al., 2017).

A review of the scientific literature of the last 10 years regarding CPR assessment mainly reflects systems based on objectives, task lists and monitoring systems of thoracic compressions and capnog-

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raphy. Currently, monitoring chest compressions and ETCO2 are the most used systems to assess CPR. A system of tasks can provide a description of the interventions fulfilled in a CPR but it does not reflect the importance weight of each intervention (Abolfotouh et al., 2017; Kawakame et al., 2015; Sheak et al., 2015).

There is no scientific evidence on the subject of evaluation systems for a complete CPR, and only one important study has been found with doctors assessing practical competences in CPR (Lyon et al., 2012). In a recent study (Peace et al., 2014), a tool monitors and records the time dedicated to each of the steps of CPR. Other studies measure the quality in virtual scenarios using mannequins focusing on the depth and frequency of the compressions (Park et al., 2014).

Feedback from experts on the topic, self-assessment and audit need to be carried out in order to improve the quality of CPR (Couper et al., 2013; Fletcher et al., 2008; Lyon et al., 2012). Due to the lack of a tool that assesses the quality of a CPR considering the differences in the importance of each intervention and activity, the aim is to create a suitable tool used to assess CPR quality and subsequently validate this tool.

Methods

The present work has been designed as an instrumental study to develop and validate a tool for the evaluation of the quality of the CPR. Participants were advised of the confidential use of their data and they were requested to sign consent forms indicating their voluntary participation in this study. For the achievement of the objectives, we set out two distinct phases.

Phase I. Development of the tool

This phase was carried out using the Delphi methodology; this method of research is based on the opinion of the experts, gathering information in a systematised mode in order to extract conclusions in a consensual way. The selection of the experts was made through intentional sampling, the Spanish Society of Emergency Medicine (SEMES) and the Spanish Society of Intensive and Critical Care Medicine and Coronary Care Units (SEMICYUC) were contacted by email, inviting their presidents to make a selection of experts (between 6 and 10 experts including doctors and nurses). The inclusion criteria were: 1) professionals who form part of one of the associations (SEMES and/or SEMICYUC), 2) being active as instructors in advanced life support (ALS), 3) more than five years experience in emergency care, and 4) currently working in the field of emergency care, resuscitation units and/or intensive care units. The initial sample of this study was formed by 15 experts from intra-hospital and out-of-hospital fields and from different geographical areas (urban and rural areas). Finally, the participant group was formed by 11 experts. The Delphi method usually recommends nine expert opinions to obtain data saturation (Cook et al., 2010; García Valdés and Suárez Marín, 2013).

The stages in which the Delphi method was developed were as follows (Fig. 1):

a) *Preparatory phase*, a set of open questions (Table 1) were addressed to the experts, they answered them by describing points to be carried out in a CPR. The result was a list of 35 items.
b) *Consultation phase*, the list of these items was sent again to the experts in order to be assessed in terms of its importance with a Likert scale of 5 points (0, 0.25, 0.5, 0.75, 1) discarding the items under an average of 0.5 points. A total of 7 items were finally discarded. At this point, an important requirement was discussed with the experts: the sum of the weights should total exactly 10 points.
c) *Phase of consensus*, the result was a list of 28 items, each one with its weight importance. This end result was forwarded to the experts so that they could confirm the consensus reached and decide if they wanted to make any changes. The experts, basing their consensus on the 2015 recommendations of the Vital Support European Resuscitation Council (ERC) and the American Heart Association (AHA), ratified the final results shown in Table 2.

Phase II. Validation of the tool

A study of inter and intrasubject reliability was made for the development of this phase. A group of 14 professionals agreed to participate through an open call to health professionals pertaining to the Management of Emergencies and 061 Emergencies of the Region of Murcia, and teachers and students of the Master of Emergency Nursing and Critical Care of the Catholic University of Murcia. The inclusion criteria were: 1) being in possession of the title of ALS, SEMES or SEMICYUC and 2) having the qualification of physician or nurse. In order to avoid biased input, participation in the first phase of this study was included as criteria for exclusion. The 14 professionals (three physicians and 11 nurses) were trained in the use of the tool. The reliability study was conducted by asking participants to view 11 videos of real and simulated CPR that were selected. Later, between the fourth and fifth week after the first assessment, the professionals were asked to repeat the process, viewing the same videos, to check temporal stability in an intrasubject term.

In order to create a gold-standard, a group of professionals composed of 6 advanced CPR instructors of SEMES or SEMICYUC (three physicians and three nurses), met the following criteria of inclusion: 1) experience in training in ALS, 2) experience of more than 6 years in emergency care. This group came to a consensus on the score of the videos that were considered as "gold standard" to compare with the results of the 14 professionals. This analysis is considered essential in the validation of the assessment instruments for obtaining samples of content and consensus validity (Carretero-Dios and Pérez, 2007; Rubio et al., 2003).

Statistical analysis

Data analysis was conducted using SPSS V. 21.0 statistical program. In the first phase, the data obtained were analyzed by calculating the average and standard deviation for each of the items included in the study. In the second phase, the intraclass correlation coefficient (ICC) (Fleiss et al., 2013; Viera and Garrett, 2005) was calculated to analyze the level of concordance between the participant's scores and the gold standard's (intersubjects' reliability). The same was calculated between participants pre and post scores (intrasubject reliability). Regarding ICC interpretation, the classification established by Landis and Koch (Landis and Koch, 1977) was followed, according to which an ICC <0.90 indicates a very good match; 0.71–0.90, good; 0.51–0.70, moderate; 0.31–0.50, mediocre, and if it is <0.31, bad.

Results

In phase I, 11 men formed the final group of experts. Their average age was 44 years, five nurses, and six physicians. Four of them belong to SEMES, five to SEMICYUC and two (a physician and a nurse) belong to both scientific societies. Their average professional experience in emergency area exceeded six years. The result was a list of 28 items, each one with its weight importance. The sum of the weights should total exactly 10 points (see Table 2).

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