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Better adherence to the guidelines during cardiopulmonary resuscitation through the provision of audio-prompts☆

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Abstract

Objective: Quality assurance to optimize clinical resuscitation performance is important. The aims of the present study were to identify the deficiencies in the clinical practice of resuscitation by motion analysis of video-recorded cardiopulmonary resuscitation (CPR), and to evaluate the effectiveness of quality improvement strategies based on audio-prompt methods.

Materials and methods: A two-stage prospective trial was conducted. The first stage (observation group) was designed to identify any major clinical nonconformity to current resuscitation guidelines by videotaped CPR sessions. The second stage (intervention group) was designed to evaluate the effectiveness of audio prompts in ameliorating the problems identified at the first stage. The demographic data of patients and CPR variables between the two groups were analysed.

Results: A total of 30 resuscitation attempts were recorded during study period: 17 patients were in the observation group and 13 patients in the intervention group. Inadequate number of chest compressions per minute, lack of re-oxygenation during prolonged intubation attempts and unnecessary hands-off periods were identified as the three most important deficiencies in CPR practice. Compared to the observation group, the intervention group showed a significant improvement in the hands-off period per minute during CPR (12.7 ± 5.3 s versus16.9 ± 7.9 s, $P < 0.05$), the total hands-off time during CPR (164 ± 94 s versus 273 ± 153 s, $P < 0.05$), the proportion of intubation attempts taking under 20 s (56.3% versus 10%, $P < 0.05$).

Conclusions: Audio-prompts can improve the adherence to current CPR guidelines in the clinical setting significantly. The quality improvement measures described in this study are helpful in translating CPR knowledge into clinical practice.

Keywords: Cardiopulmonary resuscitation (CPR); Chest compression; Intubation; Training; Quality of CPR; Audio-prompt; Hands-off periods

1. Introduction

Training programmes for cardiopulmonary resuscitation (CPR) have been implemented worldwide following the guidelines established by the American Heart Association (AHA) [1] and the European Resuscitation Council (ERC) [2]. Although healthcare professionals are expected to provide proficient resuscitation, previous studies have shown the situation to be otherwise. Some studies found that the skills involved in the performance of basic life support (BLS) are poorly acquired and poorly retained by health care professionals as well as lay persons [3,4]. Moreover, many reports in the literature revealed that CPR performance often did not comply with the recommendations. Common shortcomings included an insufficient number of compressions per minute [5–7], too rapid lung inflations [8], and too much hands-off

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time during the automated external defibrillation (AED) protocol [9]. Since it has been suggested that only effective CPR improves survival rates [10–12], quality assurance practice to optimize resuscitation performance is of paramount importance.

Many different methods have been employed to improve the resuscitation skills, including video-recording evaluation [7,13], audio-feedback system during teaching [6,14] or integrated into an automated external defibrillator [15]. Most were applied to the training environment rather than actual clinical practice. The purposes of this study were to identify defects in the clinical practice of resuscitation by motion analysis of video-recorded CPR, and to evaluate the effectiveness of quality improvement strategies based on audio-prompt methods.

2. Material and methods

From 1 September 2003 to 31 March 2004, we conducted a two-stage prospective study at the Emergency Department (ED) in National Taiwan University Hospital (NTUH). This academic hospital is located in urban area of Taipei, Taiwan, with about 100,000 ED visits per year. The first stage of the study was intended to identify the major clinical nonconformities with current resuscitation guidelines by motion analysis of videotaped CPR sessions. The second stage of the study was designed to evaluate the effectiveness of interventions aimed at ameliorating the problems identified during the first stage.

Resuscitation of adult, non-traumatic out-of-hospital cardiac arrest (OHCA) patients were recorded during the study period. OHCA patients younger than 15 years or with cardiac arrest due to trauma events were excluded. All videotapes were reviewed by the study physicians using a structured recording form designed by the principle investigators.

In the first stage from 1 September to 30 November 2003, three major discrepancies were identified between clinical CPR practice and the current guidelines. These included an inadequate number of chest compressions per minute, unnecessary hands-off periods, and intubation attempt times longer than 20 s without re-oxygenation by a bag-valve-mask (BVM). In the second stage, we attempted to improve these deficiencies in CPR practice by the audio-prompt methods. Two instruments were employed to remind the operators: the first was an audiotape recorded from a metronome at 100 bleeps/min, and the other was a siren that sounded once every 20 s. CPR practice during the second stage was also video recorded and analyzed.

The following data were recorded during the review of resuscitation videotapes before and after implementing the audio-prompt methods: patient demographic data, initial rhythm on arrival at ED, members of the resuscitation team, chest compression count in every minute, causes and length of hands-off periods in every minute, intubation time at every attempt, cause of OHCA if known, recovery of spontaneous circulation (ROSC), and survival to 7 days.

2.1. Statistical analysis

Mean and standard deviation (S.D.) were calculated as summaries of continuous variables. For categorical variables, count and percentage were computed. Unpaired Student's *t*-test was used for comparisons of continuous variables, and binominal variables were analyzed with Chi-square or Fisher's exact tests, as appropriate. $P < 0.05$ was considered significant. Data were entered into a Microsoft Excel database (Microsoft Excel 2001; Microsoft Corporation, Seattle, WA) and analyzed with SPSS software for Window (Release 10.0; SPSS Inc., Chicago, IL).

3. Results

A total of 30 resuscitation attempts were recorded during study period including 17 patients in the first stage of the trial, categorized as the observation group, and 13 patients in the secondary stage of the study, categorized as the intervention group. The basic data of enrollees and resuscitations are summarized in Table 1. There were no statistical significances between the two groups of patients in demographic data such as underlying major co-morbidity, cause of OHCA and initial rhythm identified in the ED. Compared to the observation group, the intervention group showed significant improvement in the hands-off period per minute during CPR (12.7 ± 5.3 s versus 16.9 ± 7.9 s, $P < 0.05$), the total hands-off time during CPR (164 ± 94 s versus 273 ± 153 s, $P < 0.05$) and the proportion of intubation attempts taking no longer than 20 s (56.3% versus 10%, $P < 0.05$). There were no statistical differences in the total resuscitation time, ROSC rate, or 7-day survival between the two groups.

In the observation group the total number of chest compressions in the first 3 min after initiation of resuscitation was judged as inadequate, according to the recommendations in the guidelines. The condition improved significantly after audio prompting was provided during CPR. Fig. 1 depicts the significant difference in the total number of chest compressions in the first 3 min between the two groups. When comparing the hands-off time between the two groups, the intervention group exhibited a much shorter hands-off time in the early minutes, especially in the first 2 min after the

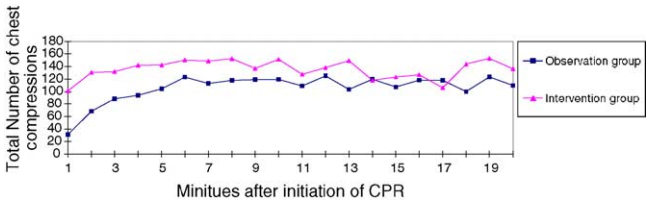

Fig. 1. Total number of chest compressions in intervention vs. observation group.