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Clinical Paper

Videographic assessment of cardiopulmonary resuscitation quality in the pediatric emergency department☆

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ABSTRACT

Objective: To describe the adherence to guidelines for CPR in a tertiary pediatric emergency department (ED) where resuscitations are reviewed by videorecording.
Methods: Resuscitations in a tertiary pediatric ED are videorecorded as part of a quality improvement project. Patients receiving CPR under videorecorded conditions were eligible for inclusion. CPR parameters were quantified by retrospective review. Data were described by 30-s epoch (compression rate, ventilation rate, compression:ventilation ratio), by segment (duration of single providers' compressions) and by overall event (compression fraction). Duration of interruptions in compressions was measured; tasks completed during pauses were tabulated.
Results: 33 children received CPR under videorecorded conditions. A total of 650 min of CPR were analyzed. Chest compressions were performed at <100/min in 90/714 (13%) of epochs; 100–120/min in 309/714 (43%); >120/min in 315/714 (44%). Ventilations were 6–12 breaths/min in 201/708 (23%) of epochs and >12/min in 489/708 (70%). During CPR without an artificial airway, compression:ventilation coordination (15:2) was done in 93/234 (40%) of epochs. 178 pauses in CPR occurred; 120 (67%) were <10 s in duration. Of 370 segments of compressions by individual providers, 282/370 (76%) were <2 min in duration. Median compression fraction was 91% (range 88–100%).
Conclusions: CPR in a tertiary pediatric ED frequently met recommended parameters for compression rate, pause duration, and compression fraction. Hyperventilation and failure of C:V coordination were very common. Future studies should focus on the impact of training methods on CPR performance as documented by videorecording.

1. Introduction

Approximately 16,000 children per year suffer an out-of-hospital or in-hospital cardiac arrest in the United States. Cardiopulmonary resuscitation (CPR) provided to these patients is guided by evidence-based recommendations drawn from the evidence review process undertaken by the International Liaison Committee on Resuscitation (ILCOR).[1] Recent studies in adults and children have demonstrated that CPR is frequently performed in a manner inconsistent with these guidelines.[2–4] Current research on improving the quality of CPR has included the use of feedback devices, novel instructional methods, and event debriefing.[5,6] In pediatrics, the majority of these studies have focused on older children and on patients in the intensive care unit.[3,7–9] CPR performance data in younger children and children in non-ICU settings is lacking in published literature.

The use of videorecording of clinical patient care is most well represented in literature focusing on trauma management and resuscitation of newborns in the delivery room. In both of these settings, video has been shown to be an effective means of evaluating crisis resource management, communication, adherence to guidelines, and accuracy of clinical assessment.[10–12] Video as a tool to assess CPR performance is predominantly reported in simulation

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literature.[13,14] Some preliminary studies in adults have examined the use of videorecording to measure clinical performance during cardiac arrest in the emergency department (ED).[15,16]

We report data from a novel quality assurance and improvement program in a tertiary pediatric ED where resuscitative care, including CPR, is videorecorded and reviewed. We sought to examine the performance of CPR on pediatric patients and describe the adherence to published guidelines as measured by video review. We hypothesized that CPR performance would be inconsistent with published guidelines and that video review would effectively demonstrate opportunities for improvement.

2. Methods

This was an observational study done in the emergency department of a single tertiary pediatric center between December 2012 and June 2014. Resuscitative care in the ED is video recorded as a part of a peer-reviewed, intradivisional continuous quality assurance program, created by a multidivisional task force including legal, risk management, and patient safety divisions. Patient/parent consent is obtained at the time of consent for treatment. Videorecording is done using three synchronized camera views (Fig. 1) plus a view of the monitor waveforms (LiveCapture, BLine Medical, Washington, DC). Videos are reviewed and deidentified data are collected on common resuscitative procedures, including CPR. Following bimonthly video review sessions and data collection, videos are deleted after 30 days and are not retained as a part of the permanent patient medical record. Because the data were collected as part of an existing quality assurance program, the study was exempted from oversight by the Institutional Review Board of the Children's Hospital of Philadelphia.

The resuscitation team in the ED consists of an attending physician, multiple trainees (pediatric and/or emergency medicine residents and pediatric emergency medicine fellows), a minimum of four nurses and technicians, and one or more respiratory therapists. CPR prompt/feedback devices (QCPR, Laerdal Medical, Stavanger, Norway) are available and are used at the treating physician's discretion.

All events where chest compressions were performed for ≥1 min were eligible for enrollment. Events that were not captured by videorecording were excluded. Data collected on patients included age category, initial rhythm, out-of-hospital versus in-hospital arrest, and outcomes according to Utstein definitions.[17] Videos were reviewed retrospectively and data on specific parameters of CPR performance were collected using the definitions below (see Table 1).[1,19]

A CPR 'event' was defined as the time from when a patient had CPR initiated (or in the case of out-of-hospital cardiac arrest had CPR taken over by the emergency department care team) to the time when return of spontaneous circulation (ROSC) occurred, extracorporeal circulatory support was successfully deployed (ECMO), or the patient was declared dead. This unit of analysis of CPR performance was used to determine the overall duration of CPR and the compression fraction.

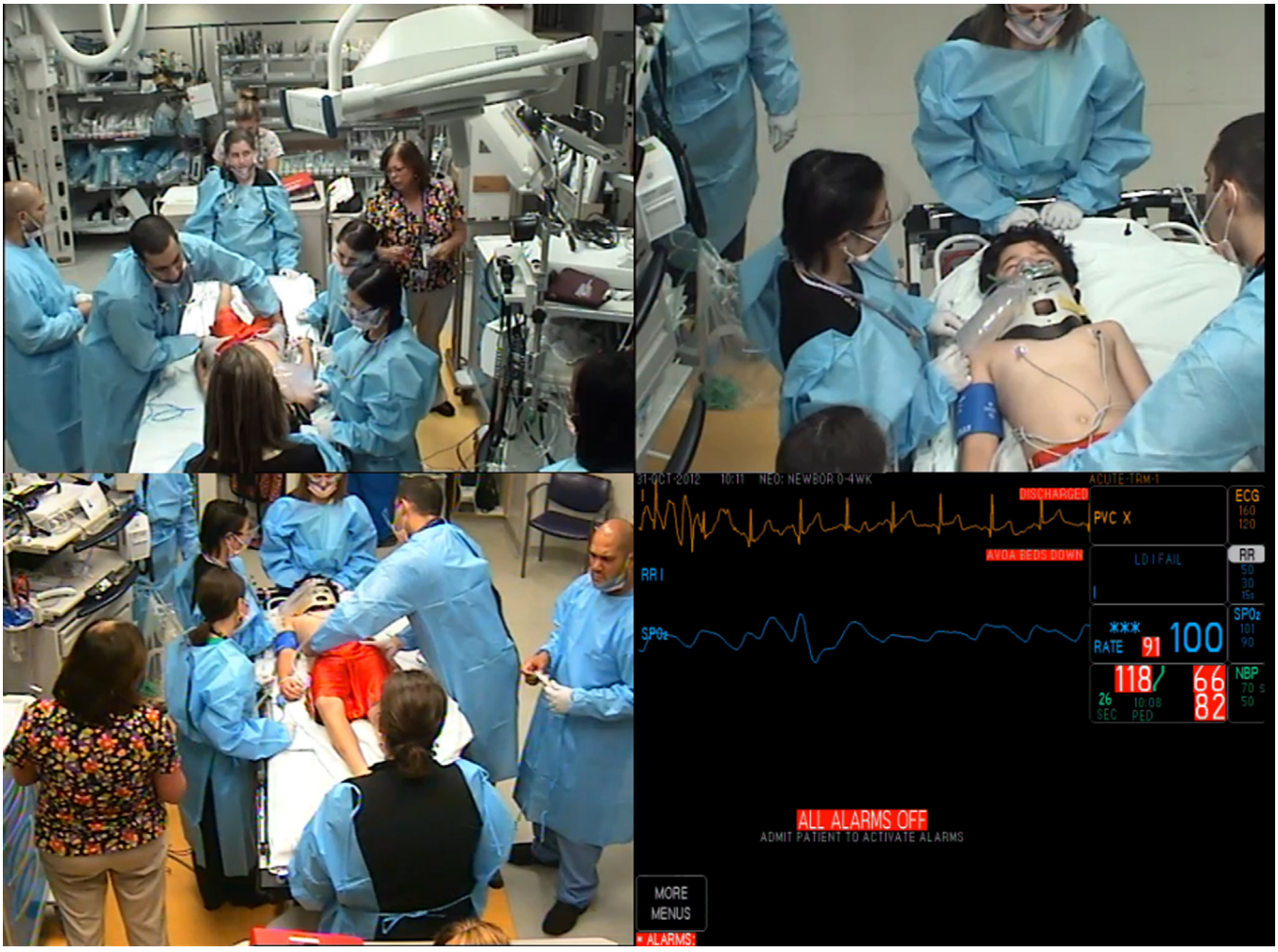

Fig. 1. Video camera configuration (example shown with simulated patient resuscitation).