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Simulation and education

Visual assessment of CPR quality during pediatric cardiac arrest: Does point of view matter?☆,☆☆

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ABSTRACT

Aim: In many clinical settings, providers rely on visual assessment when delivering feedback on CPR quality. Little is known about the accuracy of visual assessment of CPR quality. We aimed to determine how accurate pediatric providers are in their visual assessment of CPR quality and to identify the optimal position relative to the patient for accurate CPR assessment.
Methods: We videotaped high-quality CPR (based on 2010 American Heart Association guidelines) and 3 variations of poor quality CPR in a simulated resuscitation, filmed from the foot, head and the side of the manikin. Participants watched 12 videos and completed a questionnaire to assess CPR quality.
Results: One hundred and twenty-five participants were recruited. The overall accuracy of visual assessment of CPR quality was 65.6%. Accuracy was better from the side (70.8%) and foot (68.8%) of the bed when compared to the head of the bed (57.2%; $p < 0.001$). The side was the best position for assessing depth ($p < 0.001$). Rate assessment was equivalent between positions ($p = 0.58$). The side and foot of the bed were superior to the head when assessing chest recoil ($p < 0.001$). Factors associated with increased accuracy in visual assessment of CPR quality included recent CPR course completion ($p = 0.034$) and involvement in more cardiac arrests as a team member ($p = 0.003$).
Conclusion: Healthcare providers struggle to accurately assess the quality of CPR using visual assessment. If visual assessment is being used, providers should stand at the side of the bed.

1. Introduction

Pediatric cardiopulmonary arrest (CPA) is an uncommon but devastating event. The provision of high-quality chest compressions (CC) is a critical factor in determining improved survival outcomes from CPA.[1–8] A 2013 American Heart Association (AHA) Consensus statement published on the provision of cardiopulmonary resuscitation (CPR) for CPA, recommended "...monitoring of CPR quality is arguably one of the most significant advances in resuscitation ... and one that should be incorporated into every resuscitation program".[8] Monitoring of CPR quality can be based on patient physiological parameters (i.e. end tidal CO_2, arterial line tracing) and CPR performance measurement by rescuers. CPR performance by rescuers can be monitored by CPR feedback devices

Abbreviations: ACLS, Advanced Cardiac Life Support; AHA, American Heart Association; BLS, Basic Life Support; CPA, cardiopulmonary arrest; CPR, cardiopulmonary resuscitation; CC, chest compressions; ED, emergency department; PALS, Paediatric Advanced Life Support; PICU, paediatric intensive care unit.

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and/or human visual assessment. Although CPR feedback devices have shown promise in improving quality of CPR,[9–14] they have not been widely adopted by institutions, with only 4% of 439 hospitals in the USA indicating use of CPR feedback devices during clinical care.[15]

The adoption and use of CPR feedback devices in pediatric hospitals has been limited, presumably due to the small number of approved devices for infants and children. In a recent national survey of acute care providers at eight pediatric hospitals across Canada, no hospitals indicated use of CPR feedback devices while all indicated use of visual assessment of CPR quality (in isolation or in combination with physiological measures).[16] Subjective assessment of CPR quality is potentially fraught with problems. Team leaders and CPR providers consistently over-estimate the quality of CPR provided for depth and rate when surveyed after a simulated CPA event.[17] One study found that after the event, experienced team leaders managing pediatric CPA had little recall of incorrect CPR techniques that were performed.[18] Furthermore, with hands-on feedback of CPR performance, visual assessment of CPR quality does not improve even in skilled CPR instructors.[19]

No studies to date have examined the accuracy of visual assessment of CPR quality. Additionally, the optimal positioning of the observer relative to the patient for accurate assessment has yet to be determined. In this study, we aimed to address these issues by determining pediatric providers' overall accuracy when visually assessing quality of CPR. Our secondary objective was to identify the position relative to the patient for most accurate visual assessment of CPR quality.

2. Methods

We conducted a cross-sectional observational study at Alberta Children's Hospital, an academic tertiary care pediatric healthcare facility in Calgary, Alberta, Canada. Each year, between 30 and 40 patients at Alberta Children's Hospital suffer from CPAs. The majority of CPAs occur in either the pediatric intensive care unit (PICU) or emergency department (ED).

2.1. Study participants

A convenience sample of healthcare professionals from the Alberta Children's Hospital was recruited to participate in the study. Inclusion criteria included: (a) pediatric acute care providers (nurses, nurse practitioners, respiratory therapists, attending physicians, residents) and (b) providers working in the ED or PICU setting regularly or, in the case of trainees, rotating through the ED or PICU. There were no specific exclusion criteria. Institutional ethics board approval was secured and informed consent was obtained from all participants.

2.2. Study design

2.2.1. Intervention

We created 4 simulated scenarios with varying CPR quality and specific, pre-planned errors, videotaped in the KidSIM Simulation Center at Alberta Children's Hospital.

Videos were created using a pediatric manikin (SimJunior™, Laerdal Corporation), specifically designed and calibrated for CPR training (spring constant 4.46 kg/cm; 22.3 kg of force required to press to 5 cm; maximum compression depth of 7 cm).[20] Objective data for chest recoil was collected from the manikin. Objective data regarding rate and depth was collected from a CPR feedback device (Laerdal CPR Card™)[20] when creating the videos, thus allowing us to quantitatively capture and assess the quality of CPR for each video. The camera's depth of field was adjusted to depict a typical healthcare provider's point of view from each position, from a height of 5 foot 8 inches, positioned 2 feet from the side and foot of the bed, and 1 foot from the head of the bed. The simulator was placed on a hard stretcher with no mattress to eliminate mattress compressibility as a confounding variable.[21]

Fig. 1. View from the head of the bed.

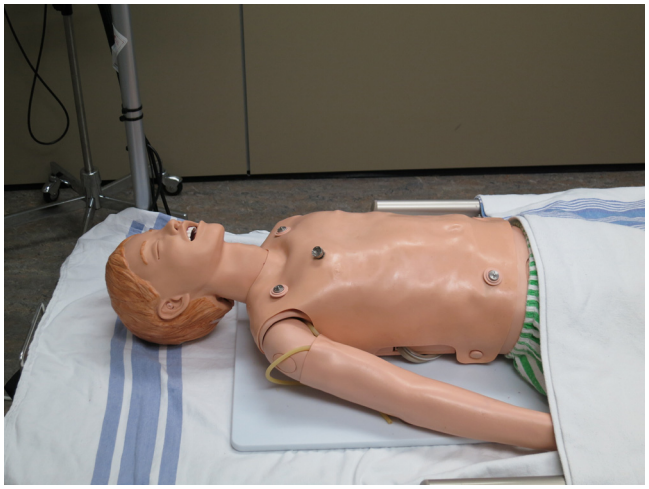

Fig. 2. View from the side of the bed.

Each scenario involved one person providing CC. One scenario depicted guideline-compliant CPR for depth, rate, and recoil.[22] To depict poor CPR, we videotaped 3 different scenarios, demonstrating the most common CPR errors: inadequate depth (too shallow), excessive rate (between 120 and 140 CC/min) and incomplete chest recoil.[6,23,24] Specifically, these videos included: one with inadequate depth (and appropriate rate and recoil), one with inadequate depth and excessively fast rate (with appropriate recoil), and one with inadequate depth, excessively fast rate and inappropriate recoil. CPR metrics were confirmed using methods as described above. Each of the 4 CPR events were simultaneously videotaped from three positions relative to the manikin: head of bed (Fig. 1), side of the bed (Fig. 2) and foot of the bed (Fig. 3).

Given the combinations described above, we recorded a total of 12 video segments. We chose a 15 s portion of each video that best represented the CPR scenario we were attempting to portray. Fifteen seconds was an estimate to reflect the approximate amount of time a provider would take to visually assess the quality of CPR during a CPA event.

Prior to watching the videos, participants filled out a brief questionnaire outlining their demographics, current practice in