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Consciousness induced during cardiopulmonary resuscitation: An observational study☆

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ABSTRACT

Background: Cardiopulmonary resuscitation-induced consciousness (CPRIC) is a phenomenon that has been described in only a handful of case reports. In this study, we aimed to describe CPRIC in out-of-hospital cardiac arrest (OHCA) patients and determine its association with survival outcomes.
Methods: Retrospective study of registry-based data from Victoria, Australia between January 2008 and December 2014. Adult OHCA patients treated by emergency medical services (EMS) were included. Multivariable logistic regression was used to determine the association between CPRIC and survival to hospital discharge.
Results: There were 112 (0.7%) cases of CPRIC among 16,558 EMS attempted resuscitations, increasing in frequency from 0.3% in 2008 to 0.9% in 2014 (p = 0.004). Levels of consciousness consisted of spontaneous eye opening (20.5%), jaw tone (20.5%), speech (29.5%) and/or body movement (87.5%). CPRIC was independently associated with an increased odds of survival to hospital discharge in unwitnessed/bystander witnessed events (OR 2.09, 95% CI: 1.14, 3.81; p = 0.02) but not in EMS witnessed events (OR 0.98, 95% CI: 0.49, 1.96; p = 0.96). Forty-two (37.5%) patients with CPRIC received treatment with one or more of midazolam (35.7%), opiates (5.4%) or muscle relaxants (3.6%). When stratified by use of these medications, CPRIC in unwitnessed/bystander witnessed patients was associated with improved odds of survival to hospital discharge if medications were not given (OR 3.92, 95% CI: 1.66, 9.28; p = 0.002), but did not influence survival if these medications were given (OR 0.97, 95% CI: 0.37, 2.57; p = 0.97).
Conclusion: Although CPRIC is uncommon, its occurrence is increasing and may be associated with improved outcomes. The appropriate management of CPRIC requires further evaluation.

Introduction

Cardiopulmonary resuscitation (CPR) typically generates only a fraction of the circulation required to maintain normal physiological function.[1] However, when performed optimally, CPR could theoretically generate sufficient cerebral blood flow to induce levels of consciousness in cardiac arrest patients.[2] Almost 30 years ago, a report by Lewinter et al. described this phenomenon in a 60 year old woman who suffered an in-hospital cardiac arrest and maintained responsiveness throughout a near three-hour resuscitation attempt.[3] Since then, a handful of case reports involving both in-hospital and out-of-hospital cardiac arrest (OHCA) patients have reported variants of CPR-induced consciousness (CPRIC), including spontaneous eye opening, increased jaw tone, speech and body movement.[4] The phenomenon may also be an extension of other undetectable levels of consciousness, such as awareness, which has been reported in survivors of cardiac arrest.[5]

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Despite the paucity of data, CPRIC may not be as uncommon as initially thought. A recent cross-sectional study of experienced resuscitationists suggests that most have observed CPRIC at least once.[6] The use of chemical sedation and paralysis are typically supported by clinicians to reduce pain and emotional distress, and to maximise the effectiveness of the resuscitation attempt.[7] However, empirical evidence supporting pharmacological interventions for CPRIC are unavailable,[8] and both the safety and efficacy of these treatments are unclear. In addition, the clinical factors associated with the development of CPRIC are also not well known.

The primary aim of this study was to identify consecutive cases of CPRIC among a large register of OHCA patients, and to describe its incidence, characteristics and association with survival to hospital discharge. In addition, we sought to describe the frequency of prehospital pharmacological interventions used to manage CPRIC, and to assess their influence on survival.

Methods

Study design

A retrospective study of registry-based data from the Victorian Ambulance Cardiac Arrest Registry (VACAR) between 1st January 2008 and 31st December 2014 was conducted. We included adult OHCA patients (aged ≥ 16 years or missing age) who underwent an attempted resuscitation by EMS personnel. Cases involving CPRIC were identified through electronic and manual review of prehospital patient care records. The study was approved by the Alfred Human Research Ethics Committee (Project No.: 293/15).

Setting

The state of Victoria, Australia operates a single EMS servicing almost 5.8 million people across more than 227,000 square kilometres. Paramedics are dispatched to suspected cardiac arrest events in a two-tiered system, including advanced life support and intensive care paramedics. In the city of Melbourne and select rural areas of Victoria, a third tier response by defibrillation-capable first responders is provided by fire-fighters and community volunteers.[9] Resuscitation guidelines in Victoria are aligned with the recommendations of the Australian and New Zealand Committee on Resuscitation.[10] Clinical practice guidelines authorize the use of laryngeal mask airway insertion and intravenous adrenaline (epinephrine) for advanced life support paramedics, and other skills such as capnography-guided endotracheal intubation (including rapid sequence intubation) and the administration of cardiotropic medications can be undertaken by intensive care paramedics. While there are no formal guidelines in Victoria on the management of CPRIC, sedation with midazolam was authorised during the study period for the management of agitated or combative patients, and to facilitate intubation in the presence of a gag reflex. Paramedics are authorised to cease resuscitation in the field if there has been no response to advanced life support interventions after 30 min.

Data sources

The VACAR has been described in detail elsewhere.[11] Since 1999, the registry has captured over 80,000 OHCA episodes attended by paramedics. The registry collects over 150 patient and treatment variables including the Utstein-style elements.[12] Data sources include electronic patient care records, first responder treatment records, call logs, hospital medical records, and telephone follow-up surveys at 12-months post-arrest for known survivors. Potential cardiac arrest cases are identified by the registry using an extremely sensitive search filter of electronic patient care records. Case ascertainment is supplemented by review of emergency call logs and first responder case records. Shortlisted cases are checked and validated manually by registry personnel. In approximately 99% of transported cases, hospital discharge status and direction is obtained from over 100 participating hospitals. Deaths are also cross-referenced against official statewide death records from the Victorian Registry of Births, Deaths and Marriages.

Case ascertainment and definitions

We defined CPRIC on the basis of limited case reports describing the event.[4] A working definition incorporating 'one or more of spontaneous eye opening, jaw tone, speech or body movement in pulseless patients undergoing active CPR' was adopted and used as the inclusion criteria. Potential cases of CPRIC were identified using a broad keyword search of select areas of the electronic patient care record, including case histories, text fields, and treatment fields. The keyword search was developed a-priori using a small number of known cases involving CPRIC, and included the following terms: 'Moving', 'held down', 'combative', 'eyes open', 'opening eyes', 'awake', 'pushing', 'pulling', 'increased motor', 'aware', 'groaning', 'reaching', and 'localising'. Keywords were used with truncation operators to improve the sensitivity of the search.

The search was initially applied to all electronic patient care records and potential matches were then cross-referenced against records of confirmed OHCA cases in the VACAR. As all cases in VACAR retain the original ambulance case identifier, the linkage does not rely on probabilistic methods of data linkage. Two investigators (A.O. and M.S.) then manually reviewed patient care records searching for inclusion criteria. Cases were excluded if the keyword matches were unrelated to the content area; or if consciousness occurred before cardiac arrest (e.g. EMS witnessed events) or post return of spontaneous circulation (ROSC). Disputes regarding case inclusion were referred to a third investigator (Z.N.). Cases meeting the eligibility criteria underwent standardised data extraction for: (i) the description of consciousness; (ii) the cardiac rhythm in which consciousness was observed; and (iii) the pharmacological agents administered to manage CPRIC. The pharmacological agents used to manage CPRIC were collected independently of any agents used to facilitate intubation.

Statistical analysis

Statistical analyses were performed using Stata Statistical Software 14 (StataCorp, 2015, College Station, TX). Given the exploratory nature of the study, a two-sided p-value of less than 0.05 was considered statistically significant for statistical analyses. The primary outcome measure was survival to hospital discharge. Continuous variables were summarized using median with interquartile range (IQR) and discrete variables were summarized using counts with proportions. A Wilcoxon-type test for trend was used to assess the yearly number of CPRIC cases across the study period. Differences in arrest characteristics and unadjusted outcomes of cases with and without CPRIC were compared using the chi-square test or the Wilcoxon rank-sum test as required. Using the same approach, we tested differences in the baseline characteristics of CPRIC patients who did and did not receive consciousness-altering medication by paramedics.

To identify arrest characteristics associated with CPRIC, we performed stepwise logistic regression analyses. To reduce the risk of confounding arrest characteristics with witness status, we performed analyses separately for unwitnessed/bystander witnessed and EMS witnessed populations. In the unwitnessed/bystander witnessed population, we included the following candidate variables in the model: age (continuous), male gender (binary), estimated time between collapse and EMS arrival exceeds 15 min (binary), time from call to EMS arrival (continuous), public location (binary),