Resuscitation 89 (2015) 50–57

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical Paper

Comparison of out-of-hospital cardiac arrest occurring before and after paramedic arrival: Epidemiology, survival to hospital discharge and 12-month functional recovery☆

Z. Nehme[a,b,*], E. Andrew[a,b], S. Bernard[a,b,c], K. Smith[a,b,d]

[a] Department of Research and Evaluation, Ambulance Victoria, Doncaster, Victoria, Australia
[b] Department of Epidemiology and Preventive Medicine, School of Public Health and Preventive Medicine, Monash University, Prahran, Victoria, Australia
[c] Intensive Care Unit, Alfred Hospital, Prahran, Victoria, Australia
[d] Discipline of Emergency Medicine, School of Primary, Aboriginal and Rural Health Care, University of Western Australia, Crawley, Western Australia, Australia

ARTICLE INFO

Article history:
Received 18 November 2014
Received in revised form
24 December 2014
Accepted 16 January 2015

Keywords:
Cardiac arrest
Cardiopulmonary resuscitation
Emergency medical services
Paramedic witnessed
Prognosis

ABSTRACT

Background: Despite immediate resuscitation, survival rates following out-of-hospital cardiac arrests (OHCA) witnessed by emergency medical service (EMS) are reportedly low. We sought to compare survival and 12-month functional recovery outcomes for OHCA occurring before and after EMS arrival.
Methods: Between 1st July 2008 and 30th June 2013, we included 8648 adult OHCA cases receiving an EMS attempted resuscitation from the Victorian Ambulance Cardiac Arrest Registry, and categorised them into five groups: bystander witnessed cases ± bystander CPR, unwitnessed cases ± bystander CPR, and EMS witnessed cases. The main outcomes were survival to hospital and survival to hospital discharge. Twelve-month survival with good functional recovery was measured in a sub-group of patients using the Extended Glasgow Outcome Scale (GOSE).
Results: Baseline and arrest characteristics differed significantly across groups. Unadjusted survival outcomes were highest among bystander witnessed cases receiving bystander CPR and EMS witnessed cases, however outcomes differed significantly between these groups: survival to hospital (46.0% vs. 53.4% respectively, $p < 0.001$); survival to hospital discharge (21.1% vs. 34.9% respectively, $p < 0.001$). When compared to bystander witnessed cases receiving bystander CPR, EMS witnessed cases were associated with a significant improvement in the risk adjusted odds of survival to hospital (OR 2.02, 95% CI: 1.75–2.35), survival to hospital discharge (OR 6.16, 95% CI: 5.04–7.52) and survival to 12 months with good functional recovery (OR 5.56, 95% CI: 4.18–7.40).
Conclusion: When compared to OHCA occurring prior to EMS arrival, EMS witnessed arrests were associated with significantly higher survival to hospital discharge rates and favourable neurological recovery at 12-month post-arrest.

1. Introduction

Out-of-hospital cardiac arrests (OHCA) witnessed by emergency medical services (EMS) account for approximately 8–11% of all resuscitation attempts from OHCA.[1] Despite immediate cardiopulmonary resuscitation (CPR) and defibrillation by paramedics, internationally reported survival to hospital discharge rates over the last three decades remain as low as 6.1%.[1]

For patients who arrest prior to EMS arrival, a reduction in EMS response time and the time to defibrillation can considerably improve survival rates.[2–4] It would therefore be expected that patients who arrest in the presence of EMS would have a corresponding improvement in survival rates. However, some reports have observed higher crude survival rates in OHCA patients who receive immediate intervention by bystanders when compared to emergency rescuers.[5–8] This apparent contradiction may be explained by differences in patient characteristics, the aetiologies of arrest, and the quality of intervention provided by bystanders and EMS personnel.

In this report, we evaluate the significance of witness status on OHCA survival and 12-month functional recovery outcomes in the Australian state of Victoria, with a particular focus on

☆ A Spanish translated version of the abstract of this article appears as Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2015.01.012.

* Corresponding author at: Department of Research and Evaluation, Ambulance Victoria, 31 Joseph Street, Blackburn North, Victoria 3130, Australia.
E-mail address: ziad.nehme@ambulance.vic.gov.au (Z. Nehme).

http://dx.doi.org/10.1016/j.resuscitation.2015.01.012
0300-9572/

comparing outcomes after adjustment for potential confounders such as witness status, bystander CPR, and public access defibrillation (PAD).

2. Methods

2.1. Study design

A retrospective observational study of OHCA cases from the Victorian Ambulance Cardiac Arrest Registry (VACAR). We included adult (≥18 years) OHCA patients of presumed cardiac aetiology, who underwent an EMS attempted resuscitation between 1st July 2008 and 30 June 2013.

2.2. Study setting

The Australian south-eastern state of Victoria has a population of almost 5.8 million people, of which 75% reside in the city of Melbourne. A single EMS system operates in the state of Victoria employing approximately 2500 advanced life support paramedics and 500 intensive care paramedics. Cardiac arrest treatment protocols follow the recommendations of the Australian Resuscitation Council (www.resus.org.au). Advanced life support paramedics are authorised to undertake laryngeal mask airway insertion and administer intravenous adrenaline (epinephrine). Intensive care paramedics undertake advanced life support skills with the addition of endotracheal intubation (including rapid sequence intubation) and a wider scope of medications. Firefighters and volunteer first responders with defibrillation and basic life support skills are also dispatched to suspected cardiac arrest events in select areas of the state.[9] In addition, approximately 1500 registered PAD sites exist in public areas across the state which can be identified by computer aided dispatch at the time of the emergency call.[10]

2.3. Data sources

Commencing in 1999, the VACAR has captured over 72,000 OHCA episodes attended by paramedics in the state of Victoria. The VACAR collects standardised data variables containing patient demographic, treatment, and operational data, including the Utstein elements.[11] In-field paramedic treatment data are captured electronically using computer tablets which are then synchronised with the organisation's clinical database.[12] The VACAR uses a highly sensitive search strategy to identify potential cardiac arrest records. Results of the search are checked for eligibility by registry staff, and supplemented by hand-searching of all emergency call logs and paper-based treatment records. Electrocardiogram recordings and case details are reviewed by senior clinical personnel in all defibrillated cases, and a 10% monthly audit is conducted on newly entered cases. Hospital medical records are reviewed for outcome and disposition data for patients transported to more than 100 hospitals participating in the VACAR.

2.4. 12-Month functional recovery

Commencing 1st January 2010, OHCA survivors undergo a structured telephone interview at 12-months post-arrest to assess functional recovery and quality of life status.[13] Patients who survive to hospital discharge are cross-checked against death records from the Victorian Registry of Births, Deaths and Marriages to ascertain patients which may have died within the 12-month follow-up period. Patients who undergo telephone follow-up complete responses to a number of health-related quality of life assessment tools including the Extended Glasgow Outcome Scale (GOSE) which measures functional recovery on an eight point scale ranging from one (death at follow-up) through to eight (upper good recovery).[14] Good functional recovery is defined as little or no change to pre-illness capacity, and may include minor neurological or psychological deficits. In this study, 12-month GOSE outcomes are reported for the period between 1st January 2010 and 30th June 2013.

2.5. Data analysis

Analyses for this study were performed using IBM® SPSS® Statistics 21 (SPSS Inc., Chicago, IL, USA). A two-sided significance level of 0.05 was employed for all hypothesis tests.

We stratified the study population into groups on the basis of witnessed status and bystander CPR: (1) bystander witnessed with bystander CPR; (2) bystander witnessed without bystander CPR; (3) not witnessed with bystander CPR; (4) not witnessed without bystander CPR; and (5) EMS witnessed. Bystander CPR was defined as any attempt at chest compressions, with or without ventilations, and was assumed to be absent if not stated ($n = 326$ or 3.8%). The variable "EMS response time" is defined as the time from emergency call receipt to arrival of the first emergency medical response team to the scene (i.e. ambulance or participating first responder). Differences in arrest characteristics, crude survival outcomes, and 12-month GOSE outcomes were described using descriptive statistics and compared across groups using the χ^2 test and Wilcoxon rank sum test as appropriate. Crude survival to hospital discharge stratified by the initial rhythm of arrest was also compared using the χ^2 test. Trends in survival across the included fiscal years were compared using the Mantel–Haenszel χ^2 test.

Three main survival outcomes were compared across witness groups using multivariable models: (1) survival to hospital (i.e. pulse present on hospital arrival); (2) survival to hospital discharge; and (3) survival to 12 months with good functional recovery (GOSE ≥7). Using logistic regression, we calculated adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the difference in survival outcomes across groups, with the 'bystander witnessed with bystander CPR' group used as the reference category. The models adjusted for the following confounding variables: age, gender, public location, metropolitan region, and an initial shockable arrest rhythm. In a sub-group analysis of patients with a shockable rhythm of arrest, we calculated the risk-adjusted odds of survival to hospital discharge in EMS witnessed cases when compared to bystander witnessed cases receiving both bystander CPR and PAD.

2.6. Ethics approval

This study, and the collection and use of VACAR data, was approved by the Department of Health Human Research Ethics Committee as a quality assurance initiative. Hospital follow-up data are collected with the approval from over 100 participating hospitals.

3. Results

During the 5-year study period, we included 8648 cases meeting the eligibility criteria: 2931 (33.9%) bystander witnessed cases, with bystander CPR; 1474 (17.0%) bystander witnessed cases, with no bystander CPR; 1664 (19.2%) unwitnessed cases, with bystander CPR; 1312 (15.2%) unwitnessed cases, with no bystander CPR; and 1267 (14.7%) EMS witnessed cases (Fig. 1).

3.1. Patient characteristics

Patient baseline characteristics for the sample population are described in Table 1. The median age of the study population was 70.0 years (IQR: 58.0–80.0) and 5941 (68.7%) cases were male.