Resuscitation 109 (2016) 110–115

Contents lists available at ScienceDirect

Resuscitation

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

Clinical paper

Characteristics of patients who are not resuscitated in out of hospital cardiac arrests and opportunities to improve community response to cardiac arrest☆

S. Rajagopal[a,b], C.R. Kaye[a], R. Lall[a], C.D. Deakin[c,d], S. Gates[a], H. Pocock[d], T. Quinn[e], N. Rees[f], M. Smyth[a,g], G.D. Perkins[a,b,*]

[a] Warwick Clinical Trials Unit, University of Warwick, Coventry CV4 7AL, UK
[b] Heart of England NHS Foundation Trust, Birmingham B9 5SS, UK
[c] NIHR Southampton Respiratory Biomedical Research Unit, University Hospital Southampton, Southampton SO16 6YD, UK
[d] South Central Ambulance Service NHS Foundation Trust, c/o Bracknell Ambulance Station, Old Bracknell Lane West, Bracknell, Berkshire RG12 7AE, UK
[e] Joint Faculty of Health, Social Care and Education, Kingston University and St. George's, University of London, London SW17 0RE, UK
[f] Pre-Hospital Emergency Research Unit, Welsh Ambulance Service NHS Trust, UK
[g] West Midlands Ambulance Service NHS Foundation Trust, Brierley Hill, West Midlands, DY5 1LX, UK

ARTICLE INFO

Article history:
Received 28 July 2016
Received in revised form
14 September 2016
Accepted 14 September 2016

Keywords:
Out of hospital cardiac arrest
Emergency Medical Services
Bystander CPR
DNACPR
Pre-hospital emergencies

ABSTRACT

Aim: This study explores why resuscitation is withheld when emergency medical staff arrive at the scene of a cardiac arrest and identifies modifiable factors associated with this decision.
Methods: This is a secondary analysis of unselected patients who sustained an out of hospital cardiac arrest attended by ambulance vehicles participating in a randomized controlled trial of a mechanical chest compression device (PARAMEDIC trial). Patients were categorized as 'non-resuscitation' patients if there was a do-not-attempt-cardiopulmonary-resuscitation (DNACPR) order, signs unequivocally associated with death or resuscitation was deemed futile (15 min had elapsed since collapse with no bystander-CPR and asystole recorded on EMS arrival).
Results: Emergency Medical Services attended 11,451 cardiac arrests. Resuscitation was attempted or continued by Emergency Medical Service staff in 4805 (42%) of cases. Resuscitation was withheld in 6646 cases (58%). 711 (6.2%) had a do not attempt resuscitation decision, 4439 (38.8%) had signs unequivocally associated with death and in 1496 cases (13.1%) CPR was considered futile. Those where resuscitation was withheld due to futility were characterised by low bystander CPR rates (7.2%) and by being female.
Conclusions: Resuscitation was withheld by ambulance staff in over one in ten (13.1%) victims of out of hospital cardiac arrest on the basis of futility. These cases were associated with a very low rate of bystander CPR. Future studies should explore strengthening the 'Chain of Survival' to increase the community bystander CPR response and evaluate the effect on the numbers of survivors from out of hospital cardiac arrest.

Introduction

When cardiac arrest occurs there is sudden cessation of circulation to the brain and other vital organs. Irreversible death will occur within minutes unless circulation is restored. The technique of CPR was first described over 50 years ago and can be used to buy time whilst reversible causes of cardiac arrest are identified and treated.[1] Previous studies have estimated that there are approximately 60,000 out of hospital cardiac arrests (OHCAs) attended by Emergency Medical Services (EMS) in the UK.[2] More recent data indicate that resuscitation is only initiated or continued by EMS in approximately 28,000 cases.[3] This suggests that in more than 50% of cardiac arrests, resuscitation is withheld by EMS. Although some OHCAs occur in the presence of healthcare staff, most occur without such individuals present. Here, bystander CPR can improve survival chances by two to four fold.[4,5] Increasing those trained in CPR in the community can dramatically impact survival and consistently features in regions reporting high survival rates.[6]

Despite its lifesaving potential, circumstances exist where attempting resuscitation is inappropriate. This includes the pres-

☆ 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.2016.09.014.

* Corresponding author at: Warwick Clinical Trials Unit, University of Warwick, Coventry CV4 7AL, UK.
E-mail address: g.d.perkins@warwick.ac.uk (G.D. Perkins).

http://dx.doi.org/10.1016/j.resuscitation.2016.09.014
0300-9572/

Box 1: Signs unequivocally associated with death (SUAD)

1. Massive cranial and cerebral destruction.
2. Hemicorporectomy or similar massive injury.
3. Decomposition/putrefaction.
4. Incineration.
5. Hypostasis.
6. Rigor mortis.
7. Fetal maceration.

Futile resuscitation.
The combination of 15 min since the onset of cardiac arrest, no bystander CPR prior to arrival of the ambulance and asystolic for more than 30 s).
(JRCALC guidelines)

ence of do not attempt cardiopulmonary resuscitation orders (DNACPR), un-survivable injuries or clear evidence of death (e.g. rigor mortis, post mortem staining). Resuscitation is also withheld by EMS when there is no prospect of success. This is defined in national guidelines when over 15 min has passed since arrest onset, no bystander CPR is provided prior to EMS arrival and the patient is in asystole.[7]

Little is known about the characteristics of patients in whom resuscitation is withheld by EMS. This study aimed to explore the reasons for withholding resuscitation when EMS arrive at a cardiac arrest and sought to identify potentially modifiable factors associated with the decision to withhold resuscitation.

Methods

This study presents a secondary analysis of all patients screened for enrollment in the PARAMEDIC trial.[8] The population reported in this trial is larger than that reported in the PARAMEDIC trial as it includes patients assessed during the set up phase of the trial. The PARAMEDIC trial was registered on the International Standard Randomised Controlled Trial Number Registry (ISRCTN08233942) and received ethical approval from Coventry Research Ethics Committee: 09/H1210/69.

Setting

The PARAMEDIC trial was a pre-hospital cluster randomised controlled trial of a mechanical chest compression device in adult out-of-hospital cardiac arrest.[8] The trial utilised 91 ambulance stations across four UK National Health Service (NHS) Ambulance Services. Ambulance vehicles were randomized to deliver manual cardiopulmonary resuscitation (CPR) or the LUCAS-2 device (Lund University Cardiopulmonary Assistance System) to eligible patients.[9] Dispatch centres were blinded to vehicle allocations and assigned the nearest ambulance or rapid response vehicle (RRV) to patients with possible cardiac arrest.

As per UK resuscitation guidelines, upon confirming cardiac arrest, EMS assessed the appropriateness of initiating resuscitation (or if it was bystander initiated, to continue it). If EMS clinicians are presented with a written DNACPR order, signs unequivocally associated with death (SUAD) or resuscitation was deemed futile (see Box 1) then EMS did not provide CPR. If resuscitation was appropriate, it was initiated according to standardised national guidelines based on European Resuscitation Council Guidelines.[7,10,11] Patients were then transported to an emergency department (with ROSC or on-going CPR) or declared deceased if no reversible causes of cardiac arrest were identified and the patient was in asystole 20 min after initiation of resuscitation.

Data collection

Information collected detailed patient characteristics (age, sex), aetiology (presumed cardiac, respiratory, submersion, traumatic, other), location (home, public place), day and time of cardiac arrest, whether the arrest was witnessed (EMS, non-EMS, unwitnessed), ambulance response time, bystander CPR (present/absent) and whether ambulance staff attempted resuscitation or not. Reasons for withholding resuscitation were also recorded. Data were transcribed from ambulance service clinical records onto trial Case Report Forms, according to the Utstein 2004 template, and entered onto a central database.[12] As it may take a few minutes after EMS arrival to establish if resuscitation is appropriate, short resuscitation attempts (where EMS resuscitation duration was under 3 min) were categorized as non-resuscitation attempts. The period of data collection was April 2010–June 2013.

Patients in whom resuscitation was not appropriate were divided into one of three 'non-resuscitation' categories; DNACPR, signs unequivocally associated with death or futile. A few patients were recorded as falling simultaneously into more than one non-resuscitation category. These patients were assigned to one non-resuscitation category based on a hierarchy as follows. Any patients with a DNACPR order, regardless of futility or signs unequivocally associated with death, were assigned to the DNACPR group. Patients with signs unequivocally associated with death or where futility criteria were met were assigned as signs unequivocally associated with death. The remaining non-resuscitation patients only fulfilled futile criteria.

Statistical analysis

Data were analysed using SPSS version 22. Descriptive statistics were generated showing patient characteristics in the non-resuscitation (DNACPR, signs unequivocally associated with death and futile) and resuscitation groups. Each non-resuscitation group was compared to the resuscitated group in a multinomial regression model. Using tolerance and variation inflation factor statistics to assess multicollinearity, the age variable and sub-categories of location and day of week were shown to introduce collinearity and violated the assumption of independence. Therefore these variables were removed from the model. The final model included sex, EMS response time, aetiology, time of day and bystander CPR with inclusion of 90.5% of the database. This model showed a good fit using the Hosmer and Lemeshow test. For each comparison, odds ratios and 95% confidence intervals (CI) were produced with the resuscitation group as the reference category. Odds ratios could not be calculated when there were no patients in a particular sub-group e.g. no DNACPR patients sustained traumatic or submersion aetiologies of arrest. These are denoted as not-applicable (N/A) in Table 2.

Results

Proportions of patients in whom resuscitation was or was not attempted

Overall, ambulance vehicles attended 11,451 OHCAs from April 15th, 2010 to June 10th, 2013. EMS attempted resuscitation in 4805 cases (42%, Table 1). Resuscitation attempts were withheld in 6646 cases (58%). Of these, 711 (6.2%) had a DNACPR, 4439 (38.8%) had signs unequivocally associated with death, and CPR was considered futile in 1496 cases (13.1%). Information about patient and cardiac arrest event characteristics are summarised in Table 1.

Patients where resuscitation was withheld due to a DNACPR

Patients with a DNACPR were less likely to be male (odds ratio 0.42 (0.35–0.50), Table 2) compared to resuscitated patients. The