



## Clinical paper

## Resuscitation attempts and duration in traumatic out-of-hospital cardiac arrest<sup>☆</sup>



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### ABSTRACT

**Background:** This study aimed to understand factors associated with paramedics' decision to attempt resuscitation in traumatic out-of-hospital cardiac arrest (OHCA) and to characterise resuscitation attempts  $\leq 10$  min in patients who die at the scene.

**Methods:** The Victorian Ambulance Cardiac Arrest Registry (VACAR) was used to identify all cases of traumatic OHCA between July 2008 and June 2014. We excluded cases  $< 16$  years of age or with a mechanism of hanging or drowning.

**Results:** Of the 2334 cases of traumatic OHCA, resuscitation was attempted in 28% of cases and this rate remained steady over time ( $p = 0.10$ ). Multivariable logistic regression revealed that the arresting rhythm [shockable (adjusted odds ratio (AOR) = 18.52, 95% confidence interval (CI): 6.68–51.36) or pulseless electrical activity (AOR = 12.58, 95%CI: 9.06–17.45) relative to asystole] and mechanism of injury [motor-cycle collision (AOR = 2.49, 95%CI: 1.60–3.86), fall (AOR = 1.91, 95%CI: 1.17–3.11) and shooting/stabbing (AOR = 2.25, 95%CI: 1.17–4.31) relative to a motor vehicle collision] were positively associated with attempted resuscitation. Arrests occurring in rural regions had a significantly lower odds of attempted resuscitation relative to those in urban regions (AOR = 0.64, 95%CI: 0.46–0.90). Resuscitation attempts  $\leq 10$  min represented 34% of cases in which resuscitation was attempted but the patient died at the scene. When these resuscitation attempts were selectively excluded from the overall EMS treated population, survival to hospital discharge non-significantly increased from 3.8% to 5.0% ( $p = 0.314$ ).

**Conclusion:** Survival in our study was consistent with existing literature, however the large proportion of cases with resuscitation attempts  $\leq 10$  min may under-represent survival in those patients that receive full resuscitation attempts.

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### Introduction

Survival from traumatic out-of-hospital cardiac arrest (OHCA) is low with a recent systematic review reporting overall survival

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of 3.3%.<sup>1</sup> Given this, the resuscitation of patients with traumatic OHCA has been considered by some to be futile and an inappropriate use of resources.<sup>2,3</sup> This perceived futility has resulted in limited research into this sub-group of OHCA and, in contrast to OHCA with a presumed cardiac aetiology, there is little known about the characteristics and outcomes of traumatic OHCA patients. Of those studies conducted in traumatic OHCA, the predominant focus has been on survival rates and predictors of survival.<sup>4–7</sup> There is a paucity of data on paramedic decisions to withhold or terminate resuscitation attempts in traumatic OHCA.

Given that the Utstein template recommends reporting survival in patients who receive any attempted resuscitation,<sup>8</sup> understand-

ing trends in selection of cases for attempted resuscitation over time may have important implications on reporting. Additionally, resuscitation attempts of presumed cardiac OHCA lasting less than or equal to 10 min have increased over time in our region,<sup>9</sup> and this has implications for both treatment practices and the reporting of survival rates. However, these trends have not previously been studied in traumatic OHCA.

In a cohort of traumatic OHCA patients, we aimed to (1) understand factors associated with withholding or commencing resuscitation, and (2) characterise the duration of resuscitation attempts in those who die at the scene.

## Methods

### Study design

A retrospective analysis of OHCA data extracted from the Victorian Ambulance Cardiac Arrest Registry (VACAR) was conducted for cases of traumatic aetiology occurring between 1st July 2008 and 30th June 2014. Cases were excluded if the patient was aged less than 16 years or had a mechanism of hanging or drowning.

### Setting

The study was conducted in the state of Victoria, Australia, which has a population of approximately 5.6 million people,<sup>10</sup> 75% of whom reside in the metropolitan region of Melbourne. Ambulance Victoria (AV) is the sole provider of emergency medical service (EMS) in the state. The state delivers a three-tiered EMS system, with Advanced Life Support Paramedics (ALS), Intensive Care Ambulance Paramedics (ICP) and first responders with basic life support (BLS) (fire fighters and volunteer Community Emergency Response Teams) who respond in selected areas of Victoria. ALS paramedics are capable of laryngeal mask airway insertion, manual defibrillation and intravenous adrenaline (epinephrine) administration. ICP paramedics, in addition to ALS skills, are authorised to perform endotracheal intubation, rapid sequence induction, Pneumocath<sup>®</sup> insertion and administer a wider range of drugs. Paramedic treatment guidelines follow the recommendations of the Australian Resuscitation Council ([www.resus.org.au](http://www.resus.org.au)).<sup>11</sup> During the study period, the treatment of traumatic OHCA followed ALS guidelines for presumed cardiac OHCA, with the addition of standard trauma management depending upon injuries sustained.

### Victorian Ambulance Cardiac Arrest Registry

AV maintains the Victorian Ambulance Cardiac Arrest Registry (VACAR), which registers and collects EMS clinical and outcome data for all OHCA attended by EMS in the state of Victoria. The registry methodology, including data capture and completeness, and quality assurance processes have been described previously.<sup>12</sup> The Victorian Department of Health Human Research Ethics Committee (HREC) has approved VACAR (No. 08/02) data collection. Ethics approval for the current study was received from the Monash University Human Research Ethics Committee (CF15/3030-2015001273).

### Withholding or ceasing resuscitation

Paramedics (ALS or ICP), but not BLS responders, are authorised to withhold or cease resuscitation in the field as guided by the AV clinical practice guidelines.<sup>13</sup> Specifically, resuscitation may be withheld when there are no signs of life and one of: (1) clear evidence of prolonged cardiac arrest (including cases where the initial rhythm is asystole, the time between collapse and arrival of EMS exceeds 10 min and there is no compelling reason to continue

resuscitation such as hypothermia), (2) injuries incompatible with life, (3) death declared by a registered medical officer, (4) an adult ( $\geq 18$ ) with an advanced care directive (ACD) or refusal of treatment certificate (ROTC), or (5) child ( $< 18$ ) with a valid Emergency Treatment Plan to not commence resuscitation. After commencing resuscitation, efforts may be ceased in adults ( $\geq 18$ ) who, after 30–45 min of ALS resuscitation have not achieved ROSC, there are no signs of life including pupil reaction and agonal/gasping respiration and no compelling reason to continue such as: (1) suspected hypothermia, (2) suspected drug overdose, (3) a child ( $< 18$ ) or (4) a family member requests continued effort. There are no specific guidelines for withholding or ceasing resuscitation for traumatic OHCA.

### Definitions

For those cases in which resuscitation was attempted but the patient was pronounced dead at the scene, resuscitation duration in minutes was defined as the time from CPR commencement by EMS to the withdrawal of all treatment following declaration of death at scene. Short resuscitation attempts were defined as those with a resuscitation duration of  $\leq 10$  min, as per Nehme et al.<sup>9</sup> VACAR defines 'prolonged downtime' as cases where the duration between collapse and arrival of EMS is presumed to be greater than 15 min. The Australian Bureau of Statistics' Section of State (SOS) classification<sup>14</sup> was used to define whether the arrest occurred in an urban or rural location. As per the SOS classification, urban centre and locality (UCL) regions with a population of less than 1000 persons were classified as rural. The 'other' category in the multivariable model and comparisons of resuscitation duration included cases involving train collisions (pedestrian) (43%), assaults (9%), fire exposure (9%), industrial events (7%) and bicycle collisions (6%).

### Statistical analysis

Event dates were stratified by financial years, as defined by 1st July until 30th June the following year. Comparisons between cases where resuscitation was commenced and those in which resuscitation was withheld were made using the  $\chi^2$  test and the Mann–Whitney *U* test where appropriate. A similar approach was used to compare those who died at the scene and those who were transported to hospital. Univariate and multivariable logistic regression models were used to investigate the association between patient, system and arrest characteristics with a paramedic's decision to commence resuscitation. As age was not associated with attempted resuscitation at the univariate level, mean imputation was conducted where age data were missing ( $n = 580$ ). The Hosmer–Lemeshow  $\chi^2$  test was used to assess model goodness of fit utilising 10 quantiles.<sup>15</sup> For those patients who had attempted resuscitation but were pronounced dead at the scene, resuscitation duration was stratified into 10 min blocks ( $\leq 10$ , 11–20, 21–30, and  $> 30$  min).<sup>9</sup> Comparisons between the categories of resuscitation duration were made using the  $\chi^2$  test and the Kruskal–Wallis test as appropriate. Temporal trends in injury mechanisms, rates of attempted resuscitation and resuscitation attempts  $\leq 10$  min were investigated using linear regression. Data analysis was performed using Stata (Version 13.1, StataCorp, College Station, TX). A *p*-value  $< 0.05$  was considered statistically significant.

## Results

### Baseline characteristics

From July 2008 to June 2014, paramedics attended 2334 cases of traumatic OHCA in Victoria, Australia, representing 7.4% of all

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