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Clinical paper

Trends in traumatic out-of-hospital cardiac arrest in Perth, Western Australia from 1997 to 2014☆

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ABSTRACT

Aim: This study aims to describe and compare traumatic and medical out-of-hospital cardiac arrest (OHCA) occurring in Perth, Western Australia, between 1997 and 2014.
Methods: The St John Ambulance Western Australia (SJA-WA) OHCA Database was used to identify all adult (≥16 years) cases. We calculated annual crude and age-sex standardised incidence rates (ASIRs) for traumatic and medical OHCA and investigated trends over time.
Results: Over the study period, SJA-WA attended 1,354 traumatic OHCA and 16,076 medical OHCA cases. The mean annual crude incidence rate of traumatic OHCA in adults attended by SJA-WA was 6.0 per 100,000 (73.9 per 100,000 for medical cases), with the majority resulting from motor vehicle collisions (56.7%). We noted no change to either incidence or mechanism of injury over the study period ($p > 0.05$). Compared to medical OHCA, traumatic OHCA cases were less likely to receive bystander cardiopulmonary resuscitation (CPR) (20.4% vs. 24.5%, $p = 0.001$) or have resuscitation commenced by paramedics (38.9% vs. 44.8%, $p < 0.001$). However, rates of bystander CPR and resuscitation commenced by paramedics increased significantly over time in traumatic OHCA ($p < 0.001$). In cases where resuscitation was commenced by paramedics there was no difference in the proportion who died at the scene (37.2% traumatic vs. 34.3% medical, $p = 0.17$), however, fewer traumatic OHCAs survived to hospital discharge (1.7% vs. 8.7%, $p < 0.001$).
Conclusions: Despite temporal increases in rates of bystander CPR and paramedic resuscitation, traumatic OHCA survival remains poor with only nine patients surviving from traumatic OHCA over the 18-year period.

Introduction

Historically, the resuscitation of patients with trauma related out-of-hospital cardiac arrest (OHCA) was considered futile, particularly when compared to outcomes achieved in OHCA of medical aetiology.[1,2] However, recent evidence suggests survival in traumatic OHCA has improved, with rates of survival reported as high as 5 to 9%.[3–7] The reasons for this increase in survival from traumatic OHCA are not clear. It is known that survival from non-traumatic OHCA is enhanced through improving each component of the 'chain of survival'.[9,10] The chain of survival consists of early: recognition of cardiac arrest, CPR, defibrillation and advanced post-resuscitation care.[11] Variations in the application and effectiveness of these key components may explain the differences in survival between medical and traumatic OHCAs.[6,12] Additionally, there is currently insufficient evidence of temporal trends in traumatic OHCA, such as incidence and aetiology, that may explain these recent increases in survival.

This study aims to describe and compare traumatic and medical OHCA in metropolitan Perth, Western Australia, between 1997

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and 2014. Specifically, we aim to investigate temporal trends in the incidence, characteristics and outcomes of traumatic OHCA, and compare these against medical OHCA.

Methods

Perth is the capital city of the state of Western Australia, with a population of 2.0 million and a land area of 5300 square kilometres.[13] St John Ambulance Western Australia (SJA-WA) is the sole provider of emergency road ambulance services in WA, with a single tiered service of advanced life support paramedics in the Perth metropolitan area.[14] The management of OHCA by SJA-WA paramedics, including the commencement and termination of resuscitation in the field, is directed by the SJA-WA cardiac arrest clinical practice guideline (CPG), which is based on the Australian Resuscitation Council guidelines.[15] Specifically, resuscitation can be withheld by paramedics in the following situations: where death has clearly occurred, where major injuries are incompatible with life, in palliative care patients where death was expected and imminent, and where an Advanced Directive is in place. Termination of resuscitation by paramedics is appropriate in cases in which all of the following apply: no response to maximal directed resuscitation by SJA-WA for at least 20 min, the arrest was not witnessed by a paramedic, the patient is asystolic and no defibrillation was delivered at any stage during the resuscitation.

Data collection

Cases were extracted from the SJA-WA OHCA database, which is maintained by the Prehospital, Resuscitation and Emergency Care Research Unit (PRECRU) located at Curtin University. Patient outcomes such as admission to hospital, survival to hospital discharge and cerebral performance score[16,17] on hospital discharge are determined through medical record review by a research nurse. All cases of OHCA with either a traumatic or medical aetiology were included for analysis. As per the recent Utstein guidelines, medical OHCA is defined as "cases where the cause of the cardiac arrest is presumed to be cardiac, other medical (e.g. anaphylaxis, asthma, GI bleed), and where there is no obvious cause of the cardiac arrest".[18] Traumatic OHCA is defined as "cardiac arrest directly caused by blunt, penetrating, or burn injury".[18] Patients aged <16 years and those with a mechanism of hanging or drowning were excluded. Arrests were classified as being unwitnessed when listed as such or when there was insufficient evidence on the witness status. Paramedic industrial action during 2008 and a migration from paper to electronic patient care records (e-PCR) in 2011 resulted in missing cases for those years; therefore cardiac arrest rates for 2008 and 2011 were estimated by averaging the preceding and subsequent years (2007 and 2009, and 2010 and 2012, respectively).

Ethics approval

The collection of SJA-WA cardiac arrest data during the study period was approved by the University of Western Australia Human Research Ethics Committee (HREC) (#RA/4/1/1004); which in 2013 was replaced by the Curtin University HREC (#128/2013). An ethics exemption was approved by Monash University HREC (#CF15/1570-2015000780), since all patient-level data analysis was undertaken at Curtin University by one of the authors (HT).

Data analysis

Annual crude and age-sex standardised incidence rates (ASIRs) were calculated. Annual rates were calculated using the Australian Bureau of Statistics population data for each year for the Perth Statistical Division[19] as denominators. ASIRs were calculated using the direct method[20] whereby annual age-sex specific incidence rates were calculated across 5-year age-groups by sex using the number of traumatic and medical OHCAs for each age-group and sex as numerators. Rates were standardised by 5-year age groups using the 2011 Australian population as the population standard.[19] As the study excluded cases with age <16 years, all population data for the 15–19 age group were adjusted to reflect a 16–19 age group by assuming an equal distribution of age (population data for the 15–19 age group was multiplied by 0.8). Temporal trends in crude incidence, ASIR, rates of bystander CPR and paramedic resuscitation, and the mechanism of injury in traumatic OHCA were assessed with linear regression using the calendar year as the independent variable. A sensitivity analysis was performed excluding data from 2008 and 2011, when the number of traumatic and medical OHCAs were estimated.

Comparisons of the patient cohort, arrest characteristics and outcomes between traumatic and medical OHCA were conducted using the chi-square test for categorical variables and the Mann-Whitney test for continuous variables. Years were grouped relative to resuscitation guideline updates in 2005[21,22] and 2010,[23,24] which were similarly reflected in ARC guidelines. The location of the arrest was grouped into those occurring in a public place and others (place of residence, nursing home and other). The mechanism of injury was grouped into motor vehicle collisions, falls from height, penetrating injuries and others (assault, work-related, train accident, electric shock, burn, fall on the same level and other). Factors affecting initiation of bystander CPR were analysed using multivariable logistic regression. Included variables were those known to influence the initiation of bystander CPR.[25] Paramedic-witnessed arrests were included in all analyses with the exception of those related to bystander CPR. Data analysis was performed using Stata (Version 13.1, StataCorp, College Station, TX) and SPSS (Version 21.0, IBM, Armonk, NY). A p-value <0.05 was considered statistically significant.

Results

From 1997 to 2014 in metropolitan Perth (Western Australia) SJA-WA attended 21,071 cases of OHCA. The aetiology of arrests remained stable over time, with 16,076 (74%) medical cases and 1354 (6%) traumatic events.

Temporal trends and characteristics of traumatic and medical OHCA

The mean annual crude incidence rate of OHCA attended by SJA-WA was 6.0 per 100,000 for traumatic cases and 73.9 per 100,000 for medical cases. These were similar to the mean annual age-sex standardised rates of 6.0 per 100,000 for traumatic cases and 87.6 per 100,000 for medical cases (Fig. 1). The incidence of medical OHCA was not linear over time ($p = 0.06$); however, we observed an early decline from 1997 to 2002 (16% reduction in incidence), a stabilization period from 2002 to 2009, followed by a 17% increase in incidence from 2009 to 2014. The incidence of traumatic OHCA for both crude ($p = 0.99$) and standardised ($p = 0.98$) rates showed no significant trend over time. The trend in standardised incidence of traumatic OHCA remained non-significant when stratified by the following age groups: 16–39 ($p = 0.11$), 40–64 ($p = 0.07$), 65–79 ($p = 0.20$) and 80 years and older ($p = 0.25$). The majority of traumatic OHCAs were due to motor vehicle collisions (MVC = 56.7%), penetrating injuries (16.7%) and falls from a height (7.5%). We noted no trends in the mechanism of injury over time ($p > 0.05$ for all) (Fig. 2).

Compared to the medical group, traumatic OHCA cases were more likely to be younger, male, occur in a public place and