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Clinical Paper

Paramedic exposure to out-of-hospital cardiac arrest is rare and declining in Victoria, Australia☆

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ABSTRACT

Background and objective: Paramedic exposure to out-of-hospital cardiac arrest (OHCA) may be an important factor in skill maintenance and quality of care. We aimed to describe the annual exposure rates of paramedics in the state of Victoria, Australia.
Methodology: We linked data from the Victorian Ambulance Cardiac Arrest Registry (VACAR) and Ambulance Victoria's employment dataset for 2003–2012. Paramedics were 'exposed' to an OHCA if they attended a case where resuscitation was attempted. Individual rates were calculated for average annual exposure (number of OHCA exposures for each paramedic/years employed in study period) and the average number of days between exposures (total paramedic-days in study/total number of exposures in study).
Results: Over 10-years, there were 49,116 OHCAs and 5673 paramedics employed. Resuscitation was attempted in 44% of OHCAs. The typical 'exposure' of paramedics was 1.4 (IQR = 0.0–3.0) OHCAs per year. Mean annual OHCA exposure declined from 2.8 in 2003 to 2.1 in 2012 ($p = 0.007$). Exposure was significantly less in those: employed part-time ($p < 0.001$); in rural areas ($p < 0.001$); and with lower qualifications ($p < 0.001$). Annual exposure to paediatric and traumatic OHCAs was particularly low. It would take paramedics an average of 163 days to be exposed to an OHCA and up to 12.5 years for paediatric OHCAs, which occur relatively rarely.
Conclusions: Exposure of individual paramedics to resuscitation is low and has decreased over time. This highlights the importance of supplementing paramedic exposure with other methods, such as simulation, to maintain resuscitation skills particularly in those with low exposure and for rare case types.

1. Introduction

Out-of-hospital cardiac arrest (OHCA) is a leading cause of death worldwide.[1] Commonly, survival from OHCA is less than 10%, without substantial improvement seen internationally in the last 30 years.[2] The quality of resuscitation care provided by paramedics has been identified as one contributor to low survival.[3–7] Poor resuscitation performance and low OHCA survival could be the result of paramedics not gaining enough exposure to OHCA to develop and maintain competency in their resuscitation skills.

Current evidence suggests that paramedic exposure to OHCA is low; with median rates varying between 4 and 9 cases per year.[8–11] However, many of these estimates are crudely calculated[11–13] and may not accurately reflect the true exposure of paramedics to resuscitation. Furthermore, there is no evidence describing regional differences in exposure (e.g. metropolitan versus rural) nor exposure to subgroups of patients that require modified or specific skills (e.g. paediatrics and trauma).

The primary aim of this study was to describe the average overall paramedic exposure to OHCA cases and in specific patient

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subgroups. A secondary aim was to determine if we could derive a crude estimate of paramedic exposure to OHCA using routinely collected data and determine whether this value accurately reflects actual exposure.

2. Methods

This study is a retrospective analysis of prospectively collected, linked data from 2003 to 2012 from the Victorian Ambulance Cardiac Arrest Registry (VACAR)[14] and Ambulance Victoria's (AV) employment dataset. This study was approved by the Monash University Human Research Ethics Committee (project number: CF13/971 – 2013000471).

2.1. Setting

The study was set in the Australian state of Victoria which covers an area of 227,000 km.[15] Victoria has a population of 5.7 million, most (75%) of whom live in the capital city of Melbourne.[15] The age-adjusted incidence of presumed cardiac aetiology OHCA in Victoria is 76.7 per 100,000 adults.[16]

AV is the sole provider of emergency medical services (EMS) in the state.[14] AV delivers a primarily two-tiered EMS, with advanced life support (ALS) and intensive care paramedics. There are also basic life support (BLS) responders, the majority of whom operate on a voluntary basis in rural areas. Fire fighters also provide a first response in select areas of Melbourne and rural communities. Paramedics in Victoria are currently required to have a three year bachelor degree in paramedicine followed by a 12-month in field graduate year and intensive care paramedics have an additional postgraduate diploma in emergency health. There is no formalised ALS accreditation or mandatory recertification of resuscitation skills for AV paramedics after university training. Where available, two intensive care paramedics and two ALS paramedics are concurrently dispatched to each OHCA.

OHCA patients are managed according to AV clinical practice guidelines,[17] which are based on recommendations by the Australian Resuscitation Council.[18] All ALS paramedics can administer intravenous adrenaline, perform manual defibrillation and insert supraglottic airways. In addition, intensive care paramedics are able to administer amiodarone, perform endotracheal intubation (ETI), insert intraosseous cannulae and provide advanced post resuscitation care (rapid sequence induction, sedation, therapeutic cooling and adrenaline infusion). AV paramedics can elect to withhold resuscitation where there is evidence of body decomposition, rigour mortis or injuries incompatible with life; or where the presenting rhythm is asystole and cardiac arrest duration is greater than 10 min. Resuscitation can be discontinued at the scene if ALS has been provided for at least 30 min, the patient is not in a shockable rhythm and there are currently no other signs of life present.[17]

2.2. Data sources

The VACAR collects Utstein[19] data elements for all OHCAs attended by EMS in Victoria. The aetiology of OHCA cases is presumed to be cardiac when no other cause is recorded on the patient care record (e.g. trauma). All OHCAs that occurred between 1 January 2003 and 31 December 2012 were included in this study.

AV's employment dataset contains information about the qualification held by paramedics, the duration of their employment and whether they are employed fulltime. The employment data captured was current as of the 31st of December 2012 or the paramedic's last day of duty. We included all AV paramedics who were 'operational' (i.e. available to be exposed to OHCA cases) at some time during the study period. We classified paramedics as working in a rural location if they treated OHCAs that occurred outside the city of Melbourne and, therefore, we were unable to determine the location of paramedics who did not attend an OHCA during the study period. Over 99% of all OHCA cases from VACAR where EMS resuscitation was attempted were linked to one or more paramedics in the AV employment dataset.

2.3. Definitions

We considered paramedics to have 'exposure' to OHCA if they attended an OHCA case where EMS resuscitation was attempted (CPR and/or defibrillation). Given we were unable to determine which individual paramedic performed which resuscitation procedure, paramedics were considered to have 'exposure' to a procedure or skill if they were in attendance when it was performed and they were qualified to perform it (i.e. all intensive care paramedics at a case were considered to have been exposed to ETI if the patient was intubated). We measured experience from each paramedic's first day of duty until their last day of duty or the last day of the study if they were still employed.

To estimate the typical exposure of a paramedic to OHCA, we first calculated the annual average exposure for each paramedic by dividing the number of OHCAs they attended by the years that they were employed during the study period. To provide an estimate of the typical exposure we then took the median of those values.

We calculated the average number of days between exposures to OHCA by dividing the total number of paramedic-days in the dataset by the number of exposures in the dataset. We defined paramedic-days as the number of days that paramedics were employed by AV during the study period.

We also calculated a crude estimate of paramedic exposure to OHCA using information commonly available to EMS providers. We calculated the crude estimate by multiplying the total number of resuscitations attempted per year by the number of paramedics normally dispatched to OHCA (four in AV) and dividing this by the number of paramedics employed.

2.4. Statistical analysis

We compared typical exposure between paramedic subgroups using the Mann–Whitney test and we used linear regression to analyse trends over the study period. We compared the crude estimate of paramedic exposure with mean exposure using concordance correlation[20] and Pearson's correlation. Statistical analyses were performed using Stata 12 (StataCorp, USA) and p-values less than 0.05 were considered statistically significant.

3. Results

3.1. Characteristics of OHCA cases

Paramedics in Victoria attended 49,116 OHCAs in the 10 year study period. Of these, 21,636 cases (44%) had paramedic attempted resuscitation. The characteristics of OHCA cases are provided in Table 1. A median of four paramedics (IQR 2–4) in two ambulances (IQR 1–2) attended cases that received an attempted resuscitation. The majority of attempted resuscitations (80%) had at least one intensive care paramedic on scene, however, they were only the first on scene 35% of the time. When an intensive care paramedic was not the first on scene, they typically arrived 5 min (IQR 1–10) after the first team.

3.2. Characteristics of paramedics

There were a total of 5673 paramedics employed during the study period (Table 2). Paramedics had a median of 5.6 years of