

Clinical Paper

Exploring which patients without return of spontaneous circulation following ventricular fibrillation out-of-hospital cardiac arrest should be transported to hospital?☆



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ABSTRACT

Background: Currently many emergency medical services (EMS) that provide advanced cardiac life support (ACLS) at scene do not routinely transport out-of-hospital cardiac arrest (OHCA) patients without sustained return of spontaneous circulation (ROSC). This is due to logistical difficulties and historical poor outcomes. However, new technology for mechanical chest compression has made transport to hospital safer and extracorporeal membrane oxygenation during cardiopulmonary resuscitation (ECPR) enabling further intervention, may result in ROSC. We aimed to explore the characteristics and outcomes of patients with OHCA who were transported to hospital with ongoing CPR in the absence of ROSC, who might benefit from this new technology.

Methods and results: The Victorian Ambulance Cardiac Arrest Registry (VACAR) was searched for adult OHCA with an initial shockable rhythm between 2003 and 2012. There were 5593 OHCA meeting inclusion criteria. Analysis was performed on 3095 (55%) of patients who did not achieve sustained ROSC in the field. Of these only 589 (20%) had ongoing CPR to hospital. There was a significant decline in rates of transport over the study period. Predictors of transport with ongoing CPR included younger patients, decreased time to first shock and intermittent ROSC prior to transport. Survival to hospital discharge occurred in 52 (9%) of patients who had ongoing CPR to hospital.

Conclusion: In an EMS that provides ACLS at scene, patients without ROSC in the field who receive CPR to hospital have poor outcomes. Developing a system which provides safe transport with ongoing CPR to a hospital that provides ECPR, should be considered.

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1. Introduction

Survival from out of hospital cardiac arrest (OHCA) remains poor, particularly in patients who do not achieve return of spontaneous circulation (ROSC) in the field.¹ Accordingly rules for when to terminate resuscitative efforts have been developed in an attempt to avoid transporting patients to hospital with no hope of survival.^{2–4} These rules include factors such as unwitnessed

cardiac arrest, an initial non-shockable rhythm, and failure to achieve ROSC in-field.

Similar guidelines have been adopted by emergency medical services (EMS) in Victoria, Australia, which require that multiple criteria be fulfilled before the termination of resuscitation in-field. These include resuscitation attempts exceeding 30 min, where ROSC has not been achieved and the patient remains in a non-shockable rhythm, without signs of life such as gasping or pupil reactions.⁵ Most patients with refractory cardiac arrest in Victoria are not transported to hospital for two reasons. Firstly, transport to hospital with manual external chest compressions within a fast moving ambulance is both impractical and hazardous for the crew. Secondly, given that advanced life support measures have been provided at the scene by paramedics, and traditionally there have been no additional treatment options in the hospital, it

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has been considered that such transport would be futile in these patients.^{6–8}

A number of recent advances have highlighted potential new treatment pathways for patients with refractory cardiac arrest. These include portable automated CPR devices, which would facilitate safe transport of a patient with CPR in progress.⁹ In addition, institution of pre-hospital therapeutic hypothermia (TH) for neuro-protection.^{10,11} Finally extracorporeal membrane assisted CPR (ECPR) for patients with refractory OHCA,^{12–14} and transfer to a cardiac catheterisation laboratory for percutaneous coronary intervention (PCI) may result in ROSC.^{15,16} Together these therapies provide new hope in this group of patients. In the present study we aimed to review the current outcomes of patients with ongoing CPR to hospital in Victoria, to determine more precisely the characteristics of patients who might be eligible for such therapies.

2. Methods

2.1. Study design and setting

We conducted a retrospective study using population-based data from the south-eastern state of Victoria (Australia) obtained from the Victorian Ambulance Cardiac Arrest Registry (VACAR).¹⁷ The state of Victoria has a current population of approximately 5.5 million, with 75% of the population located in the state's capital city of Melbourne.

Ambulance Victoria are the sole provider of the state's emergency medical services (EMS) and is described in detail elsewhere.¹⁷ Emergency call taking is performed using the medical priority dispatch system (MPDS), with advanced life support and intensive care paramedics dispatched to the majority of suspected cardiac arrests. Basic life support trained fire-fighters, equipped with automatic defibrillators, co-responded across parts of Melbourne.¹⁸ Paramedics operate under Ambulance Victoria Clinical Practice Guidelines, which follow the Australian Resuscitation Council Guidelines.⁵ Paramedics may withhold or cease resuscitation under specific circumstances, including clear evidence of prolonged arrest (e.g. rigour mortis, decomposition). Patients are transported to the nearest appropriate facility.

2.2. Victorian Ambulance Cardiac Arrest Registry (VACAR)

The VACAR captures all OHCA attended by the EMS in the state. The VACAR collects Utstein elements¹⁹ including demographics, arrest features, resuscitation care and hospital outcome data. The aetiology of cases is considered presumed cardiac when no other cause is apparent (e.g. trauma, hanging, drowning, exsanguination and other obvious non-cardiac causes). The VACAR has been approved by the Human Research Ethics Committee (HREC) at the Department of Health in Victoria. Approval for this specific data analysis was obtained from the Alfred Hospital HREC and the Research Committee of Ambulance Victoria.

2.3. Participants

The VACAR was searched for adult (aged ≥ 18 years) OHCA that received an attempted resuscitation by EMS between January 2003 and June 2012. Included in the analysis were patients with an initial shockable rhythm (ventricular fibrillation or pulseless ventricular tachycardia), who did not achieve 'sustained ROSC' in the field. Sustained ROSC was defined as the restoration of circulation and a palpable pulse at the time of scene departure.¹⁹ Cases of OHCA witnessed by paramedics were excluded.

2.4. Data analysis

The primary outcome measure was rate of transport to hospital with ongoing CPR. Survival to hospital discharge and discharge direction to home, rehabilitation or nursing facility were secondary outcome measures. Patient and arrest characteristics were tabulated with descriptive statistics and compared between patients who were transported to hospital with ongoing CPR to those declared deceased in the field. Patient characteristics in those transported with ongoing CPR who survived to hospital discharge were also compared to those transport patients who did not survive. Unadjusted analyses between groups were performed using the chi-squared test, the Mann–Whitney *U* test and the Student's *t* test as appropriate. Separate multivariate models were constructed identifying factors predictive of hospital transport with ongoing CPR and survival to hospital discharge. Predictors included in the model were considered statistically significant at a *p* value < 0.05 , and are reported as odds ratios with 95% confidence intervals and

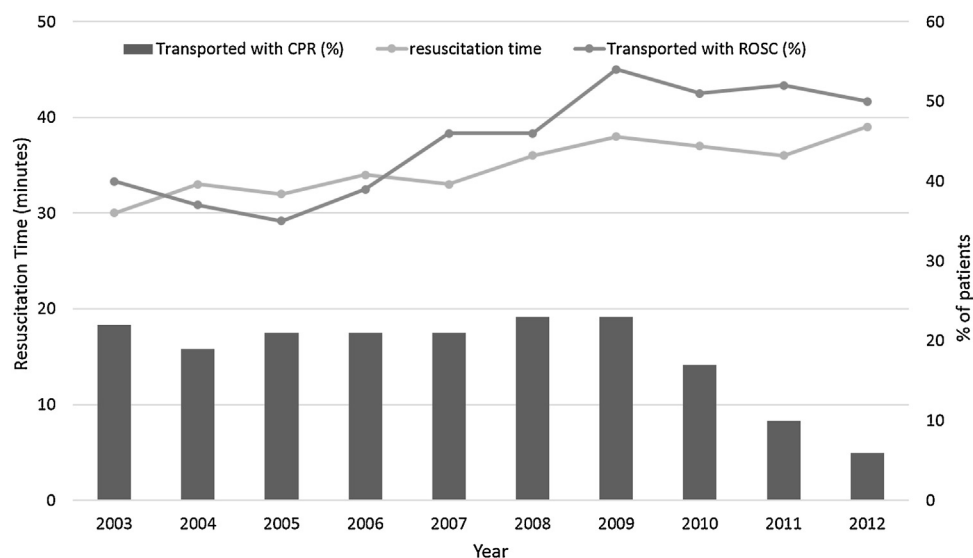


Fig. 1. Transport status of patients and field resuscitation times during study period. *P* for trend < 0.01 for resuscitation time, rate of transport with ongoing CPR and overall rate of ROSC. *Patients transported with ROSC analysed from entire cohort of patients with out of hospital cardiac arrest and initial shockable rhythm.

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