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CLINICAL PAPER

Defibrillation or cardiopulmonary resuscitation first for patients with out-of-hospital cardiac arrests found by paramedics to be in ventricular fibrillation? A randomised control trial☆,☆☆

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KEYWORDS
Advanced life support (ALS);
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Summary
Aim: To determine whether in patients with an ambulance response time of >5 min who were in VF cardiac arrest, 3 min of CPR before the first defibrillation was more effective than immediate defibrillation in improving survival to hospital discharge.
Methods: This randomised control trial was run by the South Australian Ambulance Service between 1 July, 2005, and 31 July, 2007. Patients in VF arrest were eligible for randomisation. Exclusion criteria were: (i) <18 years of age, (ii) traumatic arrest, (iii) paramedic witnessed arrest, (iv) advanced life support performed before arrival of paramedics and (v) not for resuscitation order or similar directive. The primary outcome was survival to hospital discharge with secondary outcomes being neurological status at discharge, the rate of return of spontaneous circulation (ROSC) and the time from first defibrillation to ROSC.

☆ A Spanish translated version of the summary of this article appears as Appendix in the final online version at doi:10.1016/j.resuscitation.2008.07.017.

☆☆ *Trial Registration*: This trial was registered with the Australian Clinical Trials Registry, Registration Number: ACTRN12607000401459. URL: http://actr.org.au/default.aspx.

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Defibrillation;
Paramedic;
Ventricular fibrillation

Results: For all response times, no differences were observed between the immediate defibrillation group and the CPR first group in survival to hospital discharge (17.1% [18/105] vs. 10.3% [10/97]; $P = 0.16$), the rate of ROSC (53.3% [56/105] vs. 50.5% [49/97]; $P = 0.69$) or the time from the first defibrillation to ROSC (12:37 vs. 11:19; $P = 0.49$). There were also no differences between the immediate defibrillation group and the CPR first group, for response times of $\leq$ or $>$ 5 min: survival to hospital discharge (50.0% [7/14] vs. 25.0% [4/16]; $P = 0.16$ or 12.1% [11/91] vs.7.4% [6/81]; $P = 0.31$, respectively) and the rate of ROSC (71.4% [10/14] vs. 75.0% [12/16]; $P = 0.83$ or 50.5% [46/91] vs. 45.7% [37/81]; $P = 0.54$, respectively). No differences were observed in the neurological status of those surviving to hospital discharge.
Conclusion: For patient in out-of-hospital VF cardiac arrest we found no evidence to support the use of 3 min of CPR before the first defibrillation over the accepted practice of immediate defibrillation.
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Introduction

Ventricular fibrillation (VF) is a time critical cardiac arrhythmia that results in brain damage and death within minutes, if not converted to a perfusing cardiac rhythm. While immediate defibrillation is perceived to be the treatment of choice for out-of-hospital VF cardiac arrest, in recent times, based on both scientific[1] and limited out-of-hospital clinical evidence,[2,3] the rationale behind this has been questioned. As survival rates for out-of-hospital VF cardiac arrests have not significantly improved since the introduction of defibrillators to emergency response vehicles this seems appropriate.[2,3]

Many laboratory-based animal studies suggest that cardiopulmonary resuscitation (CPR) prior to defibrillation can sufficiently reverse ischemia allowing successful defibrillation and a return of spontaneous circulation (ROSC). Recent studies by Cobb[2] and Wik[3] demonstrated that for patients experiencing out-of-hospital VF cardiac arrest with ambulance response times of $\geq$4 and >5 min, respectively, an extended period of CPR before all defibrillations was associated with an improvement in survival to hospital discharge. A recent randomised control trial by Jacobs et al.[4] however, found no improvement when CPR was performed for 90 s before the first defibrillation only.

Methods

Description of local population and criteria for selection of study participants

This study was conducted in the metropolitan and suburban areas of Adelaide, and 18 larger rural centres, in the state of South Australia by the South Australian Ambulance Service (SAAS). SAAS is the sole emergency medical response provider in the state servicing a land area of 984,377 km^2 with a population of around 1,558,200 in 2006.[5] Around 71% of the population reside in Adelaide and its immediate suburbs in a land area of around 1826 km^2 (where around 83% of patients were randomised).[5] The larger rural centres in this study had a total population of around 183,000 in 2006.[5]

Patients found to be in VF cardiac arrest on arrival of the first ambulance crew were eligible for inclusion. The exclusion criteria were: (i) age <18 years, (ii) arrest of traumatic origin, (iii) arrest witnessed by SAAS paramedics, (iv) advanced life support (ALS) given prior to arrival of paramedics (i.e. medication, defibrillation or ventilation with oxygen and appropriate airway devices) or (v) the patient was identified as being not for resuscitation.

Technical information

All emergency (000) calls for assistance were received in a centralised call centre. Computer aided despatch systems allowed retrieval of call received and scene arrival times, enabling calculation of the response time. Two crews (four officers in total) were despatched to all cardiac arrests—–one intensive care paramedic as a minimum and three paramedics. Intensive care paramedics have the skill of endotracheal intubation and a broader clinical education, enabling them to administer cardiac specific medications such as adrenaline (epinephrine), atropine, adenosine, amiodarone and lignocaine.

Patients were randomised to 3 min of CPR before the first defibrillation, or routine care (immediate defibrillation). Randomisation envelopes were prepared using the sequentially numbered opaque sealed envelopes (SNOPE) technique described by Doig and Simpson.[6] At a confirmed VF cardiac arrest the next envelope in sequence was opened and the randomisation card was followed. Hence, the paramedics were not blinded to treatment. As randomisation was performed in a time critical situation ethics approval was given by the South Australian Government Department of Health to waive informed consent on scene; it was however gained at a later time for all patients who survived to hospital.

Aside from 3 min of CPR before the first defibrillation in the intervention group, all other aspects of arrests were managed in accordance with the Australian Resuscitation Council (ARC) guideline for unwitnessed VF cardiac arrest at that time. In late April 2006 (around 300 days into this trial) SAAS, in line with recommendations from the ARC, following an extensive evaluation of current resuscitation science by the International Liaison Committee on Resuscitation, changed the guideline for unwitnessed VF arrests (the ''2006 guideline''[7] can be seen at http://www.resus.org.au/). This change was complete by mid July 2006 (around 380 days into the study) after being rolled out to around 750 paramedics across the state.

In the ''pre-2006 guideline'' patients received a salvo of three defibrillations (200, 200 and 360 J monophasic or 3$\times$ 150 J biphasic) followed by a rhythm check and 1 min of CPR. If after another rhythm check they remained in

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