Resuscitation 84 (2013) 1691–1696

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

# Treatment of monitored out-of-hospital ventricular fibrillation and pulseless ventricular tachycardia utilising the precordial thump☆

Ziad Nehme[a,b,*], Emily Andrew[a,b], Stephen A. Bernard[a,b,d], Karen Smith[a,b,c]

[a] Ambulance Victoria, Doncaster, Victoria, Australia
[b] Monash University, Prahran, Victoria, Australia
[c] University of Western Australia, Crawley, Western Australia, Australia
[d] Alfred Hospital, Prahran, Victoria, Australia

ARTICLE INFO

*Article history:*
Received 13 June 2013
Received in revised form 30 July 2013
Accepted 15 August 2013

*Keywords:*
Cardiac arrest
Precordial thump
Cardiopulmonary resuscitation
Emergency medical services

ABSTRACT

*Background:* Few studies have described the value of the precordial thump (PT) as first-line treatment of monitored out-of-hospital cardiac arrest (OHCA) from ventricular fibrillation and pulseless ventricular tachycardia (VF/VT).
*Methods:* Patient data was extracted from the Victorian Ambulance Cardiac Arrest Registry (VACAR) for all OHCA witnessed by paramedics between 2003 and 2011. Adult patients who suffered a monitored VF/VT of presumed cardiac aetiology were included. Cases were excluded if the arrest occurred after arrival at hospital, or a 'do not resuscitate' directive was documented. Patients were assigned into two groups according to the use of the PT or defibrillation as first-line treatment. The study outcomes were: impact of first shock/thump on return of spontaneous circulation (ROSC), overall ROSC, and survival to hospital discharge.
*Results:* A total of 434 cases met the eligibility criteria, of which first-line treatment involved a PT in 103 (23.7%) and immediate defibrillation in 325 (74.8%) cases. Patient characteristics did not differ significantly between groups. Seventeen patients (16.5%) observed a PT-induced rhythm change, including five cases of ROSC and 10 rhythm deteriorations. Immediate defibrillation resulted in significantly higher levels of immediate ROSC (57.8% vs. 4.9%, $p < 0.0001$), without excess rhythm deteriorations (12.3% vs. 9.7%, $p = 0.48$). Of the five successful PT attempts, three required defibrillation following re-arrest. Overall ROSC and survival to hospital discharge did not differ significantly between groups.
*Conclusion:* The PT used as first-line treatment of monitored VF/VT rarely results in ROSC, and is more often associated with rhythm deterioration.


## 1. Introduction

Since being first described by Schott in 1920 as a single sharp blow to a patient's chest, the efficacy of the precordial thump (PT) has been the subject of ongoing debate.[1] Historically, international resuscitation guidelines supported its initial application for the treatment of monitored ventricular fibrillation or pulseless ventricular tachycardia (VF/VT) where defibrillation was likely to be delayed.[2] However, the absence of empirical data demonstrating its efficacy in patients with ventricular fibrillation led to its application being limited to monitored episodes of VT.[3,4]

Theoretically, the PT remains clinically desirable. Its application can be completed in seconds after the onset of cardiac arrest and therefore reduces the time to termination of the lethal arrhythmia. This is of particular benefit in emergency medical service (EMS)-witnessed out-of-hospital cardiac arrest (OHCA), where immediate defibrillation can be complicated by patient extrication or a moving ambulance.

Over the last three decades, three non-randomised prospective studies[5–7] and a collection of case series reports[8–14] have demonstrated varying levels of effectiveness in terminating ventricular arrhythmias using a PT. Many of these reports were poorly generalisable to real-life cardiac arrest situations, and others were limited by scientific merit. Only two reports investigating the PT effects on OHCA could be identified, of which one recruited only 11 patients witnessed to arrest by EMS personnel,[6] and the other did not specify the proportion of witnessed events in the population.[8] Thus, both the effectiveness and safety profile of PT application during OHCA remain unclear.

☆ A Spanish translated version of the summary of this article appears as Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2013.08.011.

* Corresponding author at: Department of Research and Evaluation, Ambulance Victoria, 375 Manningham Road, PO Box 2000, Doncaster, Victoria 3108, Australia.
*E-mail address:* Ziad.Nehme@ambulance.vic.gov.au (Z. Nehme).

0300-9572/$ – see front matter. 
http://dx.doi.org/10.1016/j.resuscitation.2013.08.011

In this study, the impact of PT application in patients with monitored out-of-hospital VF/VT is examined, utilising prospectively collected data from a population-based registry of OHCA patients from Melbourne, Australia.

## 2. Materials and methods

### 2.1. Study design

A retrospective analysis of cases from the Victorian Ambulance Cardiac Arrest Registry (VACAR) was undertaken, for all EMS-witnessed cardiac arrest cases where resuscitation was attempted between 2003 and 2011. Adult patients aged greater than 15 years who suffered a monitored VF/VT cardiac arrest of cardiac aetiology were included. Eligible patient care records were retrieved and underwent screening by a member of the research team. Cases were excluded on review if the arrest occurred after arrival at hospital, or the patient had a 'do not resuscitate' directive. First-line treatment with PT or defibrillation was identified in all cases.

### 2.2. Setting and emergency medical service

This study was undertaken in Melbourne, Victoria, Australia's second most populous city with over four million people. The state of Victoria operates a single statewide EMS, with 1500 professional ambulance paramedics operating in the city of Melbourne. Advanced life support paramedics and intensive care paramedics are dispatched in a two-tier system to emergency medical incidents in the community. Advanced life support paramedics are authorised to undertake laryngeal mask airway insertion and administer intravenous adrenaline (epinephrine) during cardiac arrest. In addition, intensive care paramedics are authorised to undertake endotracheal intubation including rapid sequence intubation, and can administer a wider range of cardiotropic medications.

Cardiac arrest treatment guidelines follow the recommendations of the Australian Resuscitation Council (www.resus.org.au), which are similar to its international counterparts.[15] A single PT was advised if the patient suffered a monitored episode of VF/VT and defibrillation was not immediately possible.[16,17] Clinical practice guidelines recommend that paramedics deliver a PT using a single sharp blow to the patient's mid-sternum using the medial aspect of a clenched fist from a height of 20–30 cm. During the study period, all ambulances were equipped with electrical defibrillators and heart monitors as a single device, and all paramedics were capable of performing rhythm interpretation, defibrillation or PT administration as required.

### 2.3. Data sources

The VACAR records clinical and operational data from all OHCA cases where an ambulance is in attendance. Population-based case capture is assured through a statewide framework for case ascertainment, involving both electronic and paper patient care records.

Electronically captured clinical data are synchronised daily with an organisational clinical database. The VACAR identifies potential OHCA cases using a highly sensitive database search strategy, and screens individual cases for eligibility. Review of computer-aided dispatch records supplements the identification of potential cases. In the absence of electronically completed records, paramedic team managers are required to identify and submit eligible paper records to the VACAR for screening. This process is further supplemented with the screening of all paper records received by the finance and billing department.

Eligible OHCA cases are reviewed and entered into the registry according to the Utstein requirements.[18] Arrests are presumed to be of cardiac aetiology unless the aetiology is identified on the patient care record (e.g. trauma, submersion, drug overdose, exsanguination, etc.). Hospital follow-up data are obtained from hospital medical records in approximately 99% of all transported cases. Hospital outcome data are validated through cross checking of records from the Victorian Registry of Births Deaths and Marriages.

The systematic recording of PT administration is not considered a core reporting element, and thus is not easily identifiable within the VACAR database. Patient care records of eligible EMS-witnessed cases identified in the VACAR underwent manual screening and data extraction using a standardised case report form. A random audit of cases was undertaken by the lead investigators (ZN and EA), with all disagreements being resolved through consensus.

### 2.4. Statistical analyses

Cases were assigned into two groups on the basis of first-line treatment for cardioversion. Cases in the "Shock First" group received immediate defibrillation with or without cardiopulmonary resuscitation efforts. Cases assigned into the "Thump First" group received an immediate PT and ongoing resuscitation efforts as appropriate. Cases whose rhythms deteriorated into non-shockable rhythms before the administration of either intervention were excluded from group comparisons. We defined cardioversion or "successful ROSC" as the immediate restoration of a palpable carotid pulse within seconds of a shock/thump being administered. The term "rhythm deterioration" was used to describe a potentially harmful change in the patient's cardiac rhythm following first shock/thump (e.g. a change from VT into VF or other non-shockable rhythm).

Baseline characteristics, survival outcomes, and the frequency of observed rhythm changes following first intervention were presented according to treatment groups. Categorical data were reported as frequencies and proportions, and continuous data were reported using medians and interquartile range. Comparison of baseline characteristics, survival outcomes, and impact of first intervention across groups were undertaken using $\chi^2$ test, fisher's exact test, and Mann–Whitney $U$ test as appropriate. Statistical significance was determined by a threshold of $p < 0.05$. Effect size differences across groups were compared using odds ratios and 95% confidence intervals. All statistical analyses were undertaken using PASW® Statistics 18 (SPSS Inc., Chicago, IL, USA).

### 2.5. Ethics approval

Approval for the use of VACAR data in this project has been granted by the Victorian Department of Health Human Research Ethics Committee as a quality assurance project. Approval for the collection and use of patient follow-up data in the VACAR has been granted by individual hospital ethics/research committees.

## 3. Results

A total of 1379 adult EMS-witnessed OHCA events of presumed cardiac aetiology occurred in the Melbourne region between 2003 and 2011. Of these, 132 cases had missing patient care records and could not be reviewed for detail. A further 191 cases were excluded as the patient had a 'do not resuscitate' directive or arrested after arrival at hospital (Fig. 1). Cases involving VF/VT were identified in 465 of the remaining cases, although 31 (6.7%) were not monitored at the time of arrest. The final sample included 434 monitored arrests of which 308 (71.0%) were the result of VF and 126 (29.0%) of VT.

The use of the PT as first-line treatment following cardiac arrest was identified in 103 (23.7%) cases, of which 76 occurred in patients with VF and 27 in patients with VT. Of those not receiving a PT,