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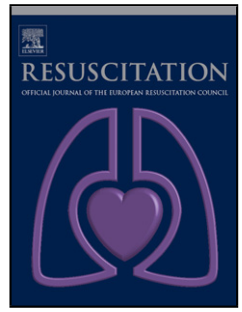

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Treatment of monitored out-of-hospital ventricular fibrillation and pulseless ventricular tachycardia utilising the precordial thump

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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.

Keywords

Cardiac arrest

Precordial thump

Cardiopulmonary resuscitation

Emergency medical services

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 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 out-of-hospital cardiac arrest (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.

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.

Materials and methods

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 individual 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.

Setting & 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 1,500 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 to 30 centimetres. 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.

Data sources

The Victorian Ambulance Cardiac Arrest Registry (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. An random audit of cases was undertaken by the lead investigators (ZN and EA), with all disagreements being resolved through consensus.

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 χ^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).

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.

Results

A total of 1,379 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, defibrillation was immediately administered in 325 (74.8%) cases. Six patients (1.4%) deteriorated into non-shockable rhythms before either intervention could be administered and were excluded from group comparisons.

Baseline patient characteristics and survival outcomes are presented in Table 1. The Shock First and Thump First groups did not differ by age, gender, location of arrest or initial presenting rhythm. The Thump First group was associated with a higher proportion of patients suffering multiple arrests (28.0% vs. 36.9%, p=0.09), and fewer patients receiving chest compressions (62.8% vs. 52.4%, p=0.06), although neither trend was statistically significant. The median time to defibrillation did not differ across groups, although the proportion of cases achieving ROSC after first shock was lower in the Thump First group (57.8% vs. 47.8%, p=0.09).

No significant differences in the frequency of scene and survival outcomes were observed across treatment groups. Return of spontaneous circulation occurred in 89.8% and 93.2% of the

Shock First and Thump First groups respectively. A total of 70.2% and 70.9% of patients were discharged alive respectively.

Table 2 describes the impact of the first shock or PT on the rhythm changes observed in each group. Application of a PT resulted in neither ROSC nor rhythm change in 86 (83.5%) patients, with only 17 (16.5%) patients obtaining a PT-induced rhythm change. A total of five patients experienced ROSC following PT application of which three occurred in the VF group and two in patients with VT. Except for two patients who were thumped from VF into VT, the remaining 10 patients sustained deteriorations in their cardiac rhythms following PT application. Ventricular fibrillation (n=8) and pulseless electrical activity (n=1) was induced in nine patients presenting in VT. Of these, only four patients with PT-induced VF survived to hospital discharge, while the patient induced into pulseless electrical activity died. One patient presenting with VF was thumped into asystole and died on scene.

An immediate shock strategy resulted in significantly higher levels of immediate ROSC when compared to the Thump First group (57.8% vs. 4.9%, OR 26.90, 95% CI 10.66 – 67.84, $p < 0.0001$). Rhythm deteriorations following immediate shock into pulseless electrical activity (n=16) and asystole (n=24) were present in the overall population, but did not differ significantly when compared to the Thump First group (12.3% vs. 9.7%, p=0.48). Within the subgroup population of VT, rhythm deteriorations were significantly lower in the Shock First group (11.4% vs. 33.3%, p=0.01), although the opposite effect was observed in the VF subgroup population (12.7% vs. 3.9%, p=0.03).

Table 3 provides a short descriptive case series of the five successful PT applications. Of these cases, three required rescue defibrillation following re-arrest.

Discussion

Recent resuscitation guidelines have recommended that a PT be reserved for the treatment of monitored and pulseless ventricular arrhythmias where a defibrillator is not immediately available.[2, 3] However, few reports have adequately assessed the utility of this procedure during monitored episodes of VF/VT. In this population-based observational study, we assessed the efficacy of the PT through a retrospective analysis of monitored OHCA.

A strength of our study is the population-based and consecutive nature of the enrolled patients, which represent 'real life' applicability to the OHCA environment. Previous work evaluating the efficacy of the PT during cardiac arrest may have been subject to selection bias and poor external validity. Early case reports involving small select populations of cardiac arrest patients reported high success rates of 36% (range 11% to 56%) for cardioverting VT.[8, 10-14] However, more recent work involving experienced cardiologists in the electrophysiology lab failed to validate these findings.[5, 7] In fact, several reports have documented that a PT is relatively ineffective during cardiac arrest. Miller et al. demonstrated that a PT had little effect in terminating ventricular tachyarrhythmias during OHCA, and was more often associated with rhythm deterioration.[8] Similarly, a non-randomised prospective study assessing the use of the PT by EMS, did not observe ROSC when utilised for all episodes of VF/VT, albeit only one was witnessed by EMS personnel.[6]

Despite a smaller sample of VT cases receiving a PT in our study (26.2%), we did not observe the rate of ROSC following PT to be significantly higher in patients presenting with VT in comparison to those in VF. While we noted a higher success rate in cardioverting VT when compared to previously published electrophysiology studies,[5, 7, 9] we could not replicate the pooled result of 36% from earlier case reports.[8, 10-14] Our observed rate of ROSC of 3.9% in patients with VF is also not significantly higher than the reported pooled result of 1.5% in a recent review study.[4]

More importantly, we observed that the PT was almost twice as likely to result in rhythm deterioration as successful ROSC. Previous studies have attributed pre-existing severe hypoxia[6, 8] or drug-induced cardio-toxicity[19] to an increased likelihood of rhythm deteriorations following PT, however we are unable to substantiate these as contributing factors in our population. Application of PT occurred within seconds of cardiac arrest onset, limiting the likelihood of hypoxia in our study population. Furthermore, this study excluded instances of cardiac arrest secondary to known drug overdoses. Instead, we surmise that like all forms of forceful mechanical stimulation of the heart, the PT carries an inherent risk of commotio cordis[20] and should not be considered an intervention without risk of adverse event.

When used as part of an ongoing resuscitation strategy, including the administration of advanced life support, we could not establish an overall balance of benefit or harm in the PT First group. However, it is clear that the use of defibrillation as a first-line intervention was significantly more likely to result in immediate ROSC and therefore potentially reduces any further arrest downtime. In addition, we observed favourable trends in the Shock First group including a greater use of chest compressions, fewer episodes of re-arrest, and a higher proportion of cases achieving ROSC following the first shock. Indeed, of the five patients who achieved ROSC following the application of PT, three required subsequent defibrillation. While we are unable to conclude that either strategy offers greater clinical benefit, it is clear that the PT as an isolated intervention offers relatively little benefit in achieving ROSC. In fact, the PT was more commonly associated with either no change in condition, or deterioration into VF, pulseless electrical activity and asystole.

Despite the widespread presence of defibrillators in our EMS, we observed a large fraction of patients receiving a PT (23.7%) with no apparent documented evidence of delay to defibrillation. Nearly all patients required some preparation for defibrillation (e.g. body positioning, stopping ambulance movement, removal of clothing, pad placement, etc.), and we can only deduce that these barriers led to the perception that a PT was reasonably warranted. Given that these delays did not appear to have a negative impact on the success of first defibrillation, there is good basis for withholding PT use until defibrillation is possible.

What remains unclear is whether the use of a PT is of greater benefit than immediate chest compressions in circumstances where defibrillation is not possible within the first few minutes of arrest. With the extensive use of defibrillators in most clinical settings, the need to resolve this uncertainty with further prospective studies is becoming less relevant.

Study limitations

Our study has several limitations. Firstly, there is always a risk of under-reporting of PT use in patient care records, which may naturally underestimate the exposed population. Secondly, a common limitation in PT studies is the potential for inconsistent application of the procedure across the study population. While this may have reduced its effectiveness, it also demonstrates the real-life nature and generalisability of its application. Finally, it is difficult to accurately determine the rate of rhythm deteriorations experienced following the application of each intervention. For example, we were aware that the presence of pulseless electrical activity after the delivery of the first shock usually resulted in delayed ROSC following a short period of chest compressions. Similarly, it is well-established that VT deteriorates into VF soon after onset of cardiac arrest, and therefore the excess rhythm deteriorations observed following PT use may have been the result of other factors.

Conclusion

First-line treatment of monitored OHCA utilising the PT rarely resulted in immediate ROSC, and was more commonly associated with rhythm deterioration. Support for its use in patients with monitored episodes of VF/VT should be re-examined.

Conflicts of interest

None declared.

Acknowledgments

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Tables

Table 1: Baseline characteristics and clinical outcomes according to treatment group.

	All Monitored n= 434	Shock First n= 325	Thump First n= 103	OR (95% CI)
Age in years, No. (%)				
16 – 30	2 (0.5)	2 (0.6)	0 (0.0)	-
31 – 45	33 (7.6)	24 (7.4)	9 (8.7)	1.20 (0.54-2.67)
46 – 60	132 (30.4)	106 (32.6)	26 (25.2)	0.70 (0.42-1.15)
61 – 75	146 (33.6)	105 (32.3)	39 (37.9)	1.28 (0.81-2.02)
≥ 76	121 (27.9)	88 (27.1)	29 (28.2)	1.06 (0.64-1.73)
Male sex, No. (%)	318 (73.3)	244 (75.1)	69 (67.0)	0.67 (0.42-1.09)
Location of arrest, No. (%)				
House	280 (64.5)	208 (64.0)	68 (66.0)	1.09 (0.69-1.74)
Aged care facility	14 (3.2)	10 (3.1)	3 (2.9)	0.95 (0.26-3.50)
Public location	64 (14.7)	48 (14.8)	16 (15.5)	1.06 (0.57-1.96)
Ambulance	69 (15.9)	53 (16.3)	15 (14.6)	0.87 (0.47-1.63)
Other	7 (1.6)	6 (1.8)	1 (1.0)	0.52 (0.06-4.38)
Rhythm on arrival, No. (%)				
Sinus Rhythm	205 (47.2)	152 (46.8)	53 (51.5)	1.25 (0.80-1.97)
Sinus Bradycardia	40 (9.2)	27 (8.3)	12 (11.7)	1.48 (0.72-3.05)
Sinus Tachycardia	56 (12.9)	44 (13.5)	10 (9.7)	0.70 (0.34-1.45)
Atrial Fibrillation	50 (11.5)	34 (10.5)	14 (13.6)	1.37 (0.71-2.68)
Ventricular Tachycardia	36 (8.3)	32 (9.8)	4 (3.9)	0.38 (0.13-1.09)
Other Rhythm	40 (9.2)	32 (9.8)	7 (6.7)	0.68 (0.29-1.59)
Unknown	7 (1.6)	4 (1.2)	3 (2.9)	-
Minutes from arrival on scene to cardiac arrest, median (IQR)	17.0 (8.0-31.0)	18.0 (8.0-31.0)	16.0 (8.0-29.3)	-
Rhythm on arrest, No. (%)				
Ventricular Fibrillation	308 (71.0)	229 (70.2)	76 (73.8)	1.18 (0.72-1.95)
Pulseless Ventricular Tachycardia	126 (29.0)	96 (29.5)	27 (26.2)	0.85 (0.51-1.40)
Chest compressions performed, No. (%)	263 (60.6)	204 (62.8)	54 (52.4)	0.65 (0.42-1.02)
Defibrillation performed, No. (%)	422 (97.2)	325 (100.0)	96 (93.2)	-
Number of arrests, mean (IQR)				
1	304 (70.0)	234 (72.0)	65 (63.1)	0.67 (0.42-1.06)
2	80 (18.4)	59 (18.2)	20 (19.4)	1.09 (0.62-1.91)
≥ 3	50 (11.5)	32 (9.8)	18 (17.5)	1.94 (1.04-3.63)
Minutes from arrest to first shock, median (IQR)	1.0 (0.0-2.0)	1.0 (0.0-2.0)	1.0 (0.0-2.0)	-
Outcome after first shock, No. (%)				
ROSC	232 (53.5)	188 (57.8)	44 (42.7)	0.67 (0.42-1.06)
No ROSC	185 (42.6)	137 (42.2)	48 (46.6)	1.50 (0.94-2.38)

Not Defibrillated‡	17 (3.9)	0 (0.0)	11 (10.7)	-
Scene outcomes, No. (%)				
Resuscitation ceased at scene	31 (7.1)	26 (8.0)	4 (3.9)	0.46 (0.16-1.36)
Transport with ROSC	307 (70.7)	234 (71.8)	72 (69.9)	0.90 (0.56-1.47)
Transport with CPR ongoing	96 (22.1)	66 (20.2)	27 (26.2)	1.39 (0.83-2.33)
ROSC at any time, No. (%)	393 (90.6)	292 (89.8)	96 (93.2)	1.55 (0.66-3.62)
Pulse at hospital arrival, No. (%)	345 (79.5)	256 (78.8)	86 (83.5)	1.28 (0.71-2.31)
Unknown	4 (0.9)	4 (1.2)	-	-
Discharged alive, No. (%)	302 (69.6)	228 (70.2)	73 (70.9)	1.02 (0.62-1.66)
Unknown	6 (1.4)	5 (1.5)	1 (1.0)	-

Abbreviations: OR, odds ratio; CI, confidence interval; IQR, interquartile range; ROSC, return of spontaneous circulation. Proportions may not add to 100% due to rounding. ‡Includes cases where ROSC was achieved prior to defibrillation, or where the rhythm deteriorated into a non-shockable rhythm before defibrillation was administered.

Table 2: Impact of first administered shock or thump on the observed rhythm changes in the overall population, and within the subgroup populations of ventricular fibrillation and pulseless ventricular tachycardia.

	All VF/VT			Ventricular Fibrillation			Pulseless Ventricular Tachycardia		
	Shock First n= 325	Thump First n= 103	OR (95% CI)	Shock First n= 229	Thump First n= 76	OR (95% CI)	Shock First n= 96	Thump First n= 27	OR (95% CI)
No change in condition, No. (%)	97 (29.8)	86 (83.5)	11.89 (6.71-21.07)†	66 (28.8)	70 (92.1)	28.81 (11.93-69.57)†	31 (32.3)	16 (59.3)	3.05 (1.27-7.34)†
ROSC, No. (%)	188 (57.8)	5 (4.9)	0.04 (0.01-0.09)†	134 (58.5)	3 (3.9)	0.03 (0.01-0.10)†	54 (56.3)	2 (7.4)	0.06 (0.01-0.28)†
Rhythm change only, No. (%)	40 (12.3)	12 (11.6)	0.94 (0.47-1.87)	29 (12.7)	3 (3.9)	0.28 (0.08-0.96)†	11 (11.4)	9 (33.3)	3.86 (1.40-10.68)†
Ventricular Fibrillation	0 (0.0)	8 (7.8)		-	-		0 (0.0)	8 (29.6)	
Pulseless Ventricular Tachycardia	0 (0.0)	2 (1.9)		0 (0.0)	2 (2.6)		-	-	
Asystole	24 (7.4)	1 (1.0)		17 (7.4)	1 (1.3)		7 (7.3)	0 (0)	
Pulseless Electrical Activity	16 (4.9)	1 (1.0)		12 (5.2)	0 (0)		4 (4.2)	1 (3.7)	

Abbreviations: VF/VT, ventricular fibrillation and pulseless ventricular tachycardia; ROSC, return of spontaneous circulation; OR, odds ratio; CI, confidence interval. Proportions may not add to 100% due to rounding. †Statistically significant ($p < 0.05$).

Table 3: Descriptive case series of cases reporting an effective precordial thump.

	Case 1	Case 2	Case 3	Case 4	Case 5
Age in years	82	81	85	49	63
Gender	Female	Female	Male	Male	Female
Primary complaint	Collapse	Chest Pain	Chest Pain	Collapse	Chest Pain
Rhythm on arrival	Sinus Bradycardia	Sinus Bradycardia	Atrial Fibrillation	Atrial Fibrillation	Sinus Tachycardia
Rhythm of arrest	VT	VF	VF	VT	VF
Rhythm after successful precordial thump	Sinus Bradycardia	Sinus Bradycardia	Atrial Fibrillation	Sinus Rhythm	Sinus Rhythm
Total number of arrests	4	1	1	2	2
Shocks after precordial thump	1	0	0	1	1
Discharged alive	Yes	Yes	Yes	Yes	Yes

Abbreviations: VF/VT, ventricular fibrillation and pulseless ventricular tachycardia

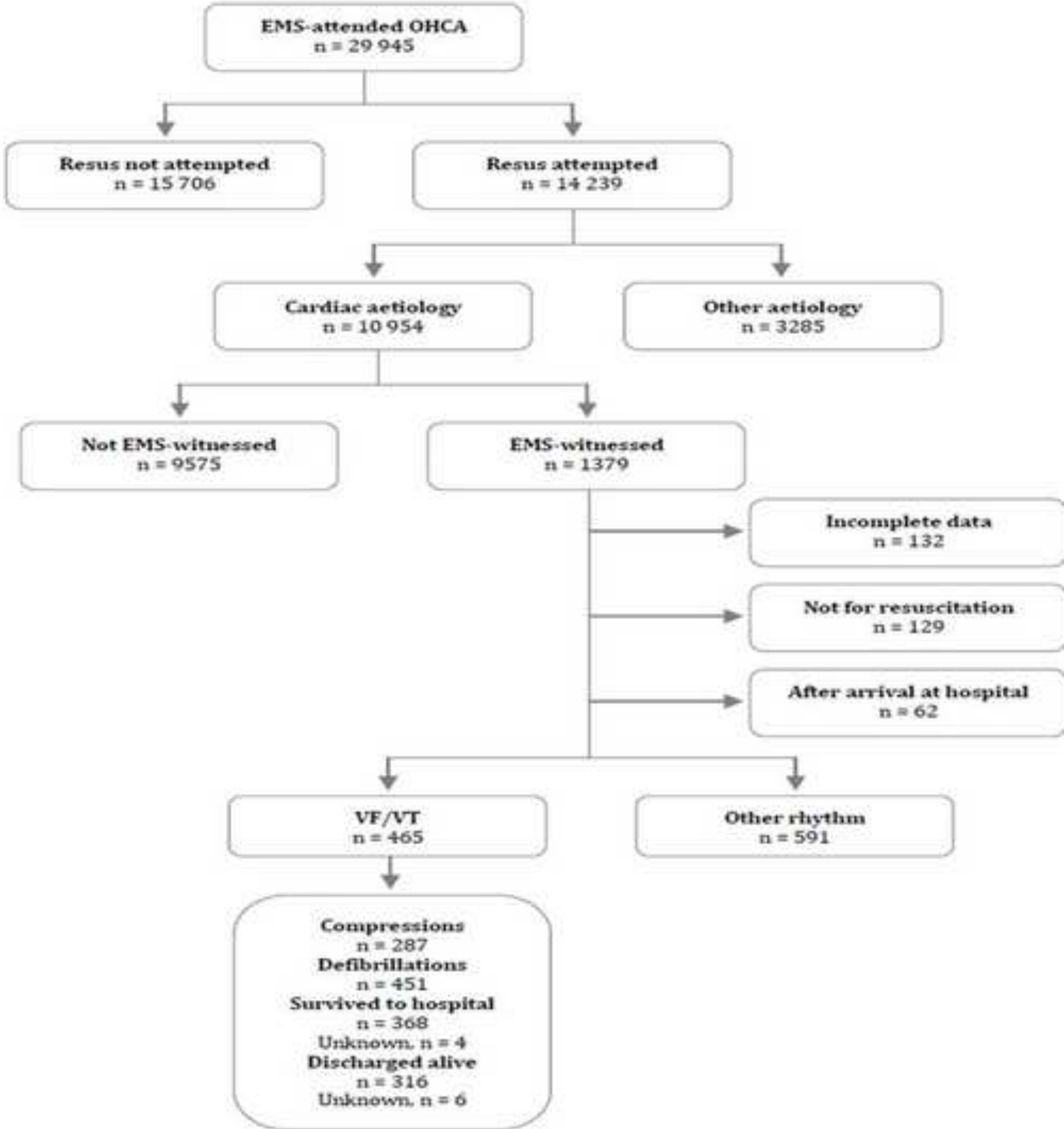
Figures

Figure 1: Utstein-style patient selection for adult monitored VF/VT events occurring in Melbourne, Australia between 2003 and 2011.

Conflicts of interest

There are no conflicts of interests disclosed by the authors.

Figure 1


EMS-attended OHCA
n = 29 945
Resus not attempted
n = 15 706
Resus attempted
n = 14 239
Cardiac aetiology
n = 10 954
Other aetiology
n = 3285
Not EMS-witnessed
n = 9575
EMS-witnessed
n = 1379
Incomplete data
n = 132
Not for resuscitation
n = 129
After arrival at hospital
n = 62
VF/VT
n = 465
Other rhythm
n = 591
Compressions
n = 287
Defibrillations
n = 451
Survived to hospital
n = 368
Unknown, n = 4
Discharged alive
n = 316
Unknown, n = 6