Relationship Between the Use of and Timing to Double Sequential External Defibrillation and Patient Outcomes after Out-of-Hospital Cardiac Arrest

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Introduction

Background: Out-of-hospital cardiac arrest (OHCA), continues to be a leading cause of death in the United States. OHCA due to ventricular fibrillation and ventricular tachycardia (VF/VT) normally respond to defibrillation. However, a subset of VF/VT cardiac arrests do not respond to repeated defibrillation attempts and are classified as shock-refractory. In these cases, double sequential external defibrillation (DSED), the use of two defibrillators with shock delivery one after the other, has been proposed as a
a treatment option in these shock refractory cases.

Aim: Investigate the use of and timing to DSED and its association with outcomes for patients suffering shock-refractory OHCA.

Methods

Study Design: This was an analysis of prospectively entered data in the Portland Cardiac Arrest Epidemiologic Registry (PDX Epistry) from January 1 2018 to December 31 2023.

Participants: We included adults (≥18 years old) with OHCA and initial rhythm of VF/VT on emergency medical services (EMS) rhythm analysis who received at least three defibrillation attempts from EMS without the return of spontaneous circulation (ROSC). We excluded patients with existing do-not-resuscitate orders, missing covariates, or missing outcomes.

Exposure: Our primary exposure variable was the use of DSED compared to single external defibrillation (routine care).

Primary Outcome: The primary outcome was return of ROSC at any time after the defibrillation attempt.

Secondary Outcomes: Secondary outcomes included ROSC at emergency department (ED) arrival (pulses palpable at time of ED handoff); survival to hospital admission; survival to hospital discharge; and good neurologic outcome (Cerebral Performance Category Score ≤2 at hospital discharge).

Statistical Analysis: We performed sequence-of-care based propensity matching, matching those exposed to DSED at the first shock this was utilized to those who remained in arrest at that same shock number but received conventional defibrillation. Matching variables included age, sex, arrest location (home or public), witness status (none, bystander, EMS), bystander cardiopulmonary resuscitation (CPR), time from dispatch to 1st EMS arrival on-scene, and time from scene arrival to initial defibrillation, initial epinephrine, initial amiodarone, and time of matching shock number. Matching was performed sequentially for patients at shock 4, 5, 6, 7, and 8 (e.g. patients received DSED initially starting at shock 6 were matched to those without ROSC up to shock 6 who at the time of shock 6 were still receiving conventional defibrillation). Matching was performed without replacement. We performed chi-squared tests and t-tests for comparisons.

Results

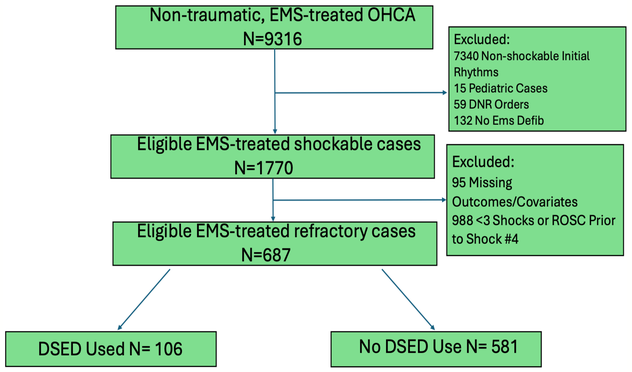

Figure 1: Inclusion criteria for our study

Table 1. Characteristics of the Study Sample by Initial DSED

	No DSED (N=581)	DSED (N=106)	p-value
Age - years, median (IQR)	63 (53-72)	62 (50-71)	0.097
Male	481 (82.8%)	90 (84.9%)	0.593
Home Arrest Location	400 (68.8%)	77 (72.6%)	0.435
Arrest Witness Status			
Unwitnessed	175 (30.1%)	38 (35.8%)	0.464
Bystander Witnessed	370 (63.7%)	63 (59.4%)	
EMS Witnessed	36 (6.2%)	5 (4.7%)	
Bystander CPR	387 (66.6%)	70 (66.0%)	0.909
Time from 911 Call to EMS Arrival	6 (4-8)	7 (5-10)	0.009
Time from 911 Call or Arrest to:			
1st EMS Defibrillation	4 (2-6)	4 (2-6)	0.788
1st Epinpehrine	7 (5-10)	7 (5-9)	0.461
1st Amiodarone	11 (8-14)	11 (8-14)	0.374

IQR = interquartile range,

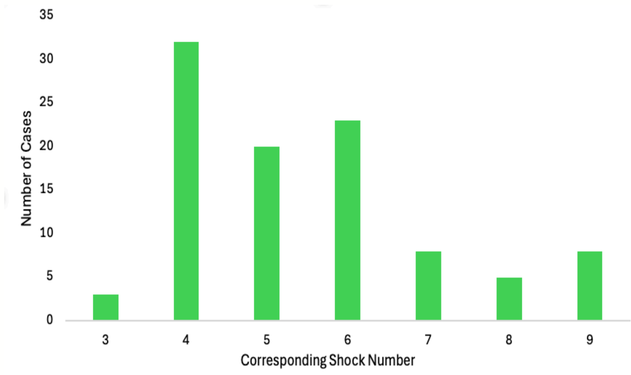

Figure 2: Histogram showing at what defibrillation during EMS care DSED was initially utilized

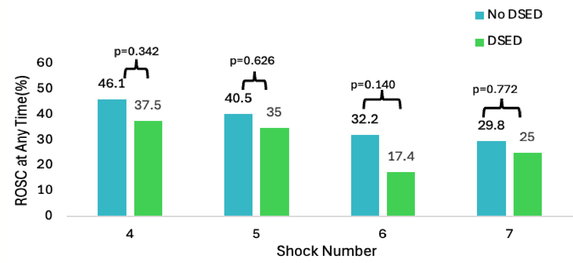

Figure 3. An unadjusted comparison of the proportion of cases with return of spontaneous circulation by the shock number where double sequential defibrillation was first utilized by emergency medical services. The control group represents patients who were still in cardiac arrest at the same shock number, but continued to receive conventional single-defibrillator shocks.

Table 2. Characteristics of the Propensity Matched Sample by Initial DSED

	No DSED (N=51)	DSED (N=51)	p-value
Age - years, median (IQR)	57 (46-67)	60 (44-69)	0.627
Male	46 (90.2%)	43 (84.3%)	0.373
Home Arrest Location	39 (76.5%)	39 (76.5%)	1.000
Arrest Witness Status			
Unwitnessed	22 (43.1%)	21 (41.2%)	0.979
Bystander Witnessed	25 (49.0%)	26 (51.0%)	
EMS Witnessed	4 (7.8%)	4 (7.8%)	
Bystander CPR	30 (58.8%)	31 (60.8%)	0.840
Time from 911 Call to EMS Arrival	6 (4-8)	6 (4-7)	0.794
Time from 911 Call or Arrest to:			
1st EMS Defibrillation	3.8 (2-5)	3 (2-6)	0.554
1st Epinpehrine	7.3 (6-9)	7 (5-9)	0.548
1st Amiodarone	11 (8-14)	11 (9-14)	0.936

IQR = interquartile range,

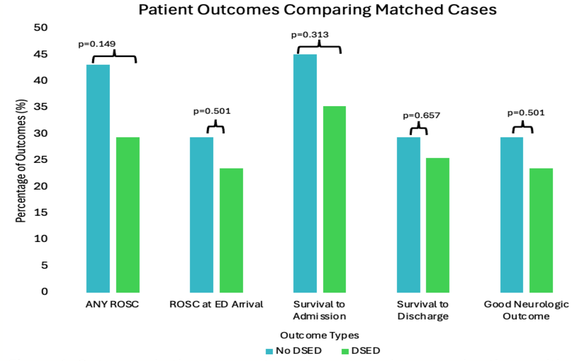

Figure 4. Outcomes in the propensity-matched sample comparing those with double sequential external defibrillation (DSED) use matched to patients at-risk at the same shock where DSED was deployed (still in cardiac arrest) but with use of routine care (single defibrillator use)

Conclusions

In this registry study, there was no significance between DSED use and patient outcomes in OHCA patients after propensity-score matching. These preliminary results may have not reached significance due to being underpowered, but suggest further external validation is needed to determine the optimal use and timing of DSED in OHCA