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Letter to the Editor

Outcomes of a 'de-emphasised' adrenaline strategy for refractory ventricular fibrillation

To the Editors,

The outcomes from refractory ventricular fibrillation (rVF) after out-of-hospital cardiac arrest (OHCA) are poor. If conventional Advanced Life Support (ALS) fails, some studies support the use of extracorporeal life support or alternative defibrillation strategies (e.g., vector change or dual sequential external defibrillation). Although adrenaline during cardiopulmonary resuscitation improves survival, the benefits are less clear in patients with shockable rhythms.[1] Furthermore, excessive catecholamine levels during rVF may lead to increased sympathetic tone with a reduction in the VF threshold.[2,3] As a result, several studies have investigated beta-blockade during rVF, with varying results.[4,5]

We evaluated the management of rVF by Hampshire & Isle of Wight Air Ambulance (HIOWAA). Adult non-traumatic OHCAs between 1st January 2019 to 24th April 2024, with a presenting rhythm of VF that was refractory to $\geq$ 5 shocks, were included. HIOWAA use a standardised operating procedure for rVF, which after 5 shocks prompts the consideration of esmolol and 'de-emphasis' of adrenaline (i.e., extending the dose interval to 8–10 min). The data collected included patient demographics, OHCA characteristics,

Table 1 – Patient demographics, OHCA characteristics, and treatment received according to whether sustained ROSC was achieved.

	All patients (n = 124)	**ROSC sustained.** (n = 44)	**ROSC not achieved or sustained.** (n = 80)	**Significant difference?** (p)
Patient Demographics				
Male Sex	102 (82)	37 (84)	65 (81)	0.808
Age	62 (53 – 71)	61 (53 – 69)	62 (54 – 73)	0.562
OHCA Characteristics				
Witnessed	107 (86)	41 (93)	66 (83)	0.111
Bystander CPR	112 (90)	41 (93)	71 (89)	0.536
Bystander AED used	19 (15)	6 (14)	13 (16)	0.798
No Flow Time (mins)	0 (0 – 2)	0 (0 – 2)	0 (0 – 2)	0.194
Low Flow Time (mins)	57 (49 – 69)	44 (30 – 53)	61 (56 – 75)	<0.001
Treatment				
Number of Shocks	9 (7 – 11)	8 (6 – 10)	10 (7 – 12)	0.121
Total Adrenaline Dose (mg) (until final VF occurrence)	4 (2 – 5)	3 (2 – 5)	4 (2 – 6)	0.006
1st Anti-Arrhythmic Dose (Amiodarone 300 mg)	124 (100)	44 (100)	44 (100)	1.000
2nd Anti-Arrhythmic Dose (Amiodarone 150 mg)	91 (73)	28 (64)	63 (79)	0.090
Vector Change Defibrillation After 3rd Shock	38 (31)	13 (30)	25 (31)	1.000
Adrenaline De-Emphasised After 5th Shock	21 (17)	11 (25)	10 (13)	0.085
3rd Anti-Arrhythmic Dose (Lidocaine 100 mg)	25 (20)	6 (14)	19 (24)	0.243
Esmolol 0.5 mg/kg Bolus	22 (18)	8 (18)	14 (18)	1.000

Abbreviations: cardiopulmonary resuscitation (CPR), automated external defibrillator (AED), helicopter emergency medical service (HEMS), return of spontaneous circulation (ROSC), out-of-hospital cardiac arrest (OHCA).

Footnotes: Fisher's exact and Mann Whitney U tests used to compare for differences between groups, with p values representing the results of this. Continuous and categorical data is presented as median (inter-quartile range) and number (percentage) respectively. We define 'no flow' time as collapse to CPR start, and 'low flow' time as CPR start to sustained ROSC/death/hospital admission (excluding periods of intermittent ROSC).

and treatment received (including whether a documented 'de-emphasised' adrenaline strategy was adopted after the 5th shock). The primary outcome was ROSC sustained for ≥ 20 mins. We conducted a multivariable logistic regression analysis (incorporating variables with $p < 0.10$ in univariate regression), and report adjusted Odds Ratios (aORs) for sustained ROSC. We used SPSS for our analysis, with $p < 0.05$ taken as significant. The study used routinely collected data and was approved as a service evaluation.

We included 124 OHCAs (Table 1). The median number of shocks and total adrenaline dose (until the final VF occurrence) were 9 (IQR 7 – 11) and 4 mg (IQR 2 – 5) respectively. Adrenaline was 'de-emphasised' in 21 patients (17%) and 22 patients (18%) received esmolol. We achieved a sustained ROSC in 44 patients (35%). In a multivariable logistic regression analysis (incorporating low flow time, number of shocks, total adrenaline dose, and whether the 2nd amiodarone dose was given or adrenaline de-emphasised), the only variables independently associated with sustained ROSC was a 'de-emphasised' adrenaline strategy (aOR 6.69, 95% CI 1.81 – 24.69, $p = 0.004$) and low flow time (aOR 0.89 per minute, 95% CI 0.85–0.94, $p < 0.001$).

We show here that a documented 'de-emphasised' adrenaline strategy is independently associated with sustained ROSC in patients with VF refractory to 5 shocks. One possible explanation for this is that supraphysiological doses of adrenaline induce myocardial stress which hinders defibrillation attempts.[2,3] However, our cohort is reflective of HIOWAA's selective dispatch criteria, with a high proportion of witnessed OHCAs with immediate bystander CPR. Furthermore, we chose ≥ 5 shocks as our inclusion criteria, as our SOP complies with conventional ALS until after this. Nevertheless, we believe our findings highlight the need for future prospective studies to investigate the role of adrenaline in rVF.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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