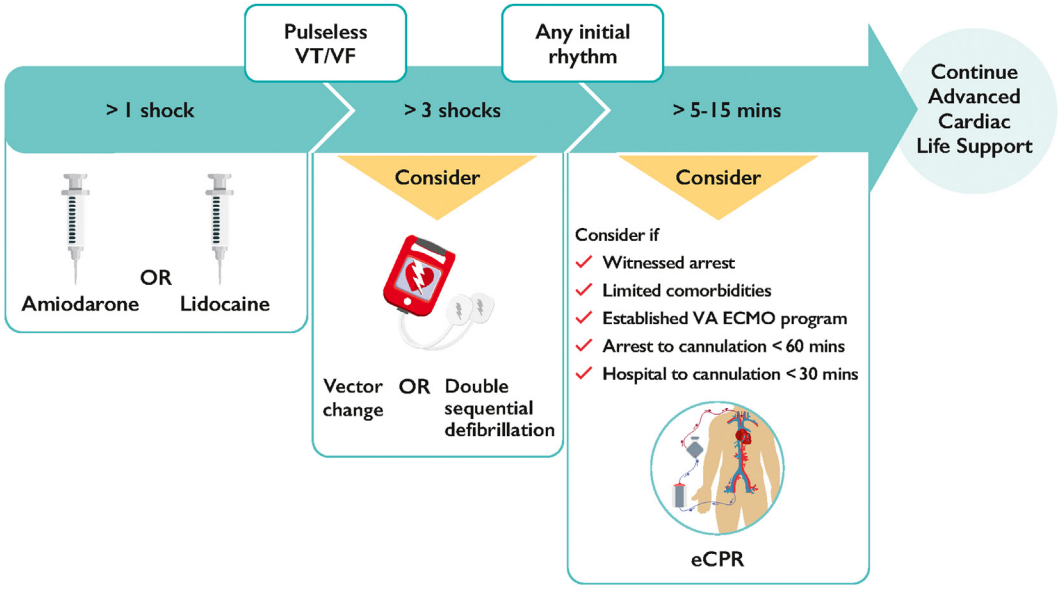

Figure 3. Strategies to potentially improve survival in patients with refractory cardiac arrest. eCPR, extracorporeal cardiopulmonary resuscitation; VA-ECMO, venoarterial extracorporeal membrane oxygenation; VF, ventricular fibrillation; VT, ventricular tachycardia.

similar in the amiodarone, lidocaine, and placebo groups (18.8%, 17.5%, 16.6%, respectively). Notably, the survival rate was higher with amiodarone (27.7%) and lidocaine (27.8%) compared with placebo (22.7%) among the 1934 patients with a bystander-witnessed arrest. Other notable prespecified exploratory outcomes included higher rates of survival to hospital admission, fewer shocks needed to terminate arrhythmias after admission to hospital, a reduced need for CPR during hospitalization among patients who received amiodarone or lidocaine (vs placebo) in the shock-refractory arrest setting, and higher rates of ROSC at emergency department (ED) arrival with patients who received lidocaine compared with placebo. However, these differences did not translate into overall improved survival to hospital discharge or higher rates of favourable neurological outcomes. Also, it remains unclear whether these results can be extrapolated to the IHCA population.

Expert Opinion: In patients with an OHCA who remain in VF or pVT after 1 or more defibrillation attempts, either amiodarone or lidocaine may be administered, particularly in patients with witnessed arrest.

Defibrillation strategies patients with refractory cardiac arrest with shockable rhythms

High-quality compressions and early defibrillation are the only interventions that reduce mortality in patients with VF or pVT. Despite technological advances and public health initiatives, up to 45% of patients with shockable OHCA remain in refractory VF/ventricular tachycardia, typically defined as the absence of ROSC after 3 shocks at 2-minute intervals.[58,59]

There have been small studies to evaluate different defibrillation strategies in patients with refractory shockable cardiac arrest including anterolateral vs anteroposterior pad placement, the use of paddles vs adhesive pads, or anatomic chest compression (compressing the chest and left ventricle with pressure in the midchest at the internipple line) that showed no clear differences in outcomes.[60] In addition, 4 RCTs and a systematic review showed no difference in ROSC or mortality in comparisons of monophasic vs biphasic defibrillation.[60]

New strategies such as double sequential defibrillation (2 shocks from 2 separate defibrillators with anterolateral and anteroposterior pad placement) have been postulated to improve defibrillation success by immediately delivering a second shock after the heart is preconditioned by the first. In the **Do**uble **Se**quential External Defibrillation for Refractory **V**entricular **F**ibrillation (DOSE VF) trial 405 prehospital patients with refractory VF/ventricular tachycardia (no response to 3 standard shocks) were randomized to double sequential external defibrillation, or a vector change defibrillation (moving from anterolateral to anteroposterior), or standard anterolateral defibrillation.[59] ROSC rates in the double sequential, vector change, and standard defibrillation arms were 46.4%, 35.4%, 26.5%, respectively. In the intention to treat analysis, double sequential (30.4%) and vector change (21.7%) significantly improved the primary outcome of survival to hospital discharge compared with standard defibrillation (13.3%). Survival with good neurological recovery was only significantly higher with double sequential (27.4%) compared with standard defibrillation (11.2%). Although the study results are encouraging, the trial had several important methodological limitations, which included early termination because of COVID-19, a lower than expected event rate, a low fragility index, a high crossover rate (12.3%), and a per-protocol analysis that showed no outcome differences. Considering the large investment in infrastructure/training, stronger evidence is required to inform large-scale changes in advanced cardiac life support (ACLS). Nevertheless, consideration of these strategies might still be reasonable because of the low risk of the intervention along