Management of Refractory Ventricular Fibrillation with Double Sequential Defibrillation

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Abstract
Patients experiencing cardiac arrest are treated according to ACLS protocols; however, current protocols lack recommendations for the treatment of refractory Ventricular Fibrillation which persists after more than 3 cycles of CPR and defibrillation. One potential intervention for these cases that is being researched is the use of simultaneous or sequential activation of two defibrillators. This literature review analyzed the results of several studies to determine if double sequential defibrillation (DSD) is a viable treatment to achieve return of spontaneous circulation (ROSC) and improved patient survival. The results of the studies were mixed with some showing positive outcomes, and others showing no significant difference. Although more research is needed, providers should keep this treatment in mind when there are no other options available.

Introduction
Each year in the US, more than 559,000 people will experience out of hospital sudden cardiac arrest. The most common presenting arrhythmia in these patients is Ventricular Fibrillation (VF) which is treatable by emergent defibrillation, however, when patients continue to experience refractory VF after more than 3 defibrillation attempts, the mortality rate approaches 85-97%. Given this high mortality rate, there is a need to explore additional options for the resuscitation of patients in refractory VF. The goal of this analysis is to determine if in adult patients (ages 18+) in cardiac arrest with refractory ventricular fibrillation, the use of Double Sequential Defibrillation (DSD) improves chances of achieving ROSC (∙) compared to traditional single defibrillation and ACLS protocols [C]?

Methods
A literature search on the topic of Double Sequential Defibrillation (DSD) was conducted in November 2019 using the EBSCOhost Academic Search Ultimate, PubMed MEDLINE, and Clinical key databases. A detailed analysis was then performed using a total of 7 articles meeting the selection criteria for study design, study population, intervention, and relevance.

Results
The evidence collected from these studies gives mixed results about the efficacy of using DSD for patients in refractory VF.

Studies showing no significant improvement in any of the reported outcomes:

Studies showing significant improvement in all reported outcome measures:

Table 1: Summary of Results

<table>
<thead>
<tr>
<th>Study</th>
<th>ROSC</th>
<th>Termination of VF</th>
<th>Survival to Hospital Admission</th>
<th>Survival to Hospital Discharge</th>
<th>CPC Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beck LR, et al.</td>
<td>NS</td>
<td>N/A</td>
<td>NS</td>
<td>NS</td>
<td>N/A</td>
</tr>
<tr>
<td>Cherkes S, et al.</td>
<td>S</td>
<td>S</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Cortez E, et al.</td>
<td>ID</td>
<td>S</td>
<td>N/A</td>
<td>ID</td>
<td>NS</td>
</tr>
<tr>
<td>Emmerson AC, et al.</td>
<td>NS</td>
<td>N/A</td>
<td>NS</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Hoch DH, et al.</td>
<td>S</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Merlin MA, et al.</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>ID</td>
<td>NS</td>
</tr>
<tr>
<td>Ross EM, et al.</td>
<td>NS</td>
<td>N/A</td>
<td>NS</td>
<td>NS</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Any: S = Significant, NS = Not Significant, N/A = Outcome was not reported in this study, ID = Unable to draw conclusion due to incomplete data presented in the study or lack of a sufficient control group

Discussion
While the results of these trials were mixed, flaws in the study designs such as small sample sizes, and delayed use of DSD during the resuscitation attempts may be partially to blame. In addition, comparison of the studies is difficult due to differences in the outcome measures reported, the positioning of the second set of defibrillator pads on the patient, and differences in the timing of the activation of the two defibrillators. No negative health outcomes were reported, and therefore further studies on the topic of DSD should be encouraged.

Conclusion
Further research on DSD is warranted to gain additional knowledge about how this treatment potentially works, and to address the shortcomings of the studies analyzed here. Although the evidence supporting the use of DSD for refractory VF remains insufficient, resuscitation teams may consider DSD when all other options have been explored and death will result if no other actions are taken.

References