

# 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 359,000 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 [P], will the use of Double Sequential Defibrillation [I] improve chances of achieving ROSC [O] when 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.

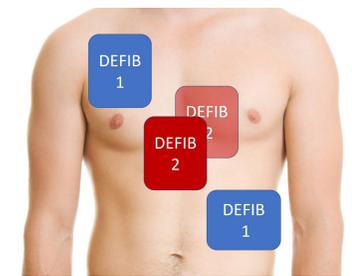
## Results

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:**
  - Beck LR, et al. Effectiveness of Prehospital Dual Sequential Defibrillation for Refractory Ventricular Fibrillation and Ventricular Tachycardia Cardiac Arrest.
    - RCA of 310 patients with the use of simultaneous activation of 2 defibrillators, after a minimum of 3 single defibrillation attempts.
  - Emmerson AC, et al. Double sequential defibrillation therapy for out-of-hospital cardiac arrests: The London experience.
    - RCA of 220 patients with the use of dual sequential defibrillation after a minimum of 6 single defibrillation attempts.
  - Ross EM, et al. Dual defibrillation in out-of-hospital cardiac arrest: A retrospective cohort analysis.
    - RCA of 279 patients with the use of simultaneous activation of 2 defibrillators after a minimum of 4 single defibrillation attempts.
- ◆ **Studies showing significant improvement in all reported outcome measures:**
  - Cheskes S, et al. The impact of double sequential external defibrillation on termination of refractory ventricular fibrillation during out-of-hospital cardiac arrest.
    - RCA of 252 patients with use of dual sequential defibrillation after a minimum of 3 single defibrillator shocks.
  - Hoch DH, et al. Double sequential external shocks for refractory ventricular fibrillation.
    - RCS of 5 patients with use of dual sequential defibrillation after a minimum of 7 single defibrillation attempts.
  - Merlin MA, et al. A Case Series of Double Sequence Defibrillation.
    - RCS of 7 patients with the use of simultaneous activation of 2 defibrillators after a minimum of 3 single shocks.
- ◆ **Study showing that DSD was effective at significantly improving termination of VF, but not significant at improving the Cerebral Performance Category (CPC) score of the patients:**
  - Cortez E, et al. Use of double sequential external defibrillation for refractory ventricular fibrillation during out-of-hospital cardiac arrest.
    - RCA of 12 patients with the use of dual sequential defibrillation after a minimum of 5 single shocks.

## 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.

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Table 1: Summary of Results

Study	ROSC	Termination of VF	Survival to Hospital Admission	Survival to Hospital Discharge	CPC Score
Beck LR, et al.	NS	N/A	NS	NS	N/A
Cheskes S, et al.	S	S	N/A	N/A	N/A
Cortez E, et al.	ID	S	N/A	ID	NS
Emmerson AC, et al.	NS	N/A	NS	NS	N/A
Hoch DH, et al.	S	N/A	N/A	N/A	N/A
Merlin MA, et al.	S	S	S	ID	ID
Ross EM, et al.	NS	N/A	NS	NS	NS

Key: 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