Dual Sequence Defibrillation

A Case Study in Refractory Ventricular Fibrillation

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01

Imagine This...

What’s this? Dual Sequence Defibrillation?

Dr. Adal – “Sure, but what are the chances?”

The Emergency Room Gods… ”Hold my beer.”

CPR, BLS only, 10 minutes out

Report: Defib x 6, still doing CPR

Me: 🤘🤘

Dr. Adal: <eyebrow raised> “You’re kidding me. Let’s do this.”

Dr. Vizzuso “Someone want to fill me in on what’s going on?”

02

Calm is Smooth; Smooth is Fast

Staff

MD head of bed

Primary RN

RN - Document/Meds

Two techs - EKG and compressions

RT

Not involved, not in the room.

Preparation

Two monitors on two code carts

12 Lead

IV/phlebotomy supplies

Ultrasound

Ventilator

History

Found unresponsive on sidewalk

Well-dressed

No ID

Small currency dollar bills in his pocket

No obvious signs of trauma

Pre-Hospital

CPR by BLS/PD (unknown downtime)

IN Narcan

Six defib prior to hospital

One more defib in ambulance bay

Charge and Delivery

Charge both defib to max (e.g. 200j biphasic)

Shock delivered in rapid succession (<1 second)

Some studies have two different providers delivering shock, others have one deliver shock.

Labs

Trop: 19K

K: 4.0

Mag: 2.5

Normal core temp – started hypothermia protocol

Other

EF ~30% with poor wall motion

Pan scan: temporal bone fracture

No bleed

Neuro

Myoclonic jerking

Keppra bolus

Versed and Propofol

Pinpoint pupils

Breathing over vent

No corneal or gag reflexes

Conclusion

Police have missing person report 48 hours later

Hx Schizophrenia, HLD

Identity confirmed by family

Withdraws care

Pronounced

“[We] gave the family a chance to say goodbye.”

Dr. Nick Vizzuso

03

Refractory Ventricular Fibrillation Defined

“Refractory VF, pragmatically defined as a shockable presenting rhythm that is still observed after three shocks and associated 2-minute CPR cycles” - AHA

04

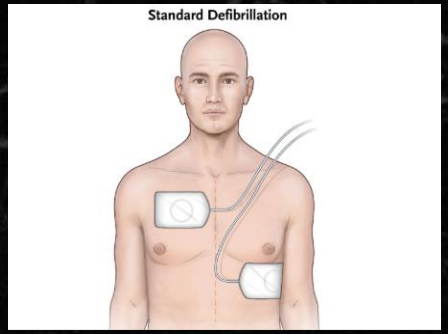
What is DSD?

Defined: “…the technique of providing two rapid shocks from two defibrillators with pads placed in the anterior-lateral and anterior-posterior position.”

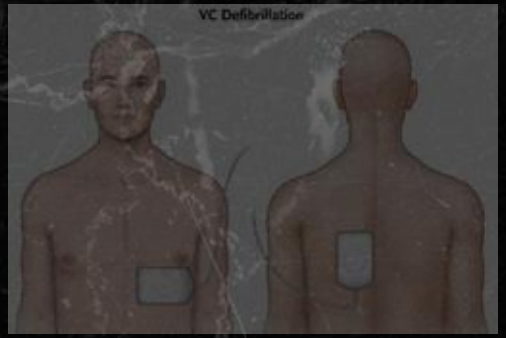
05

Defib Pad Placement

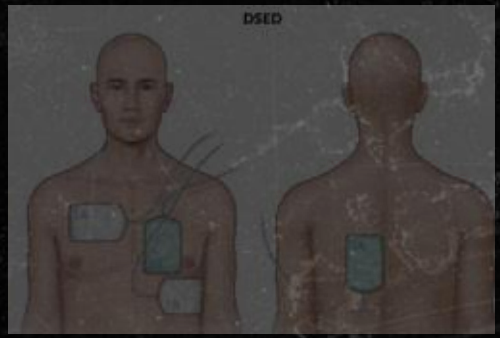
STANDARD



VECTOR CHANGE



DUAL SEQUENCE



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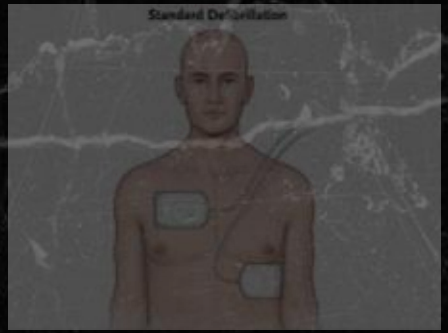
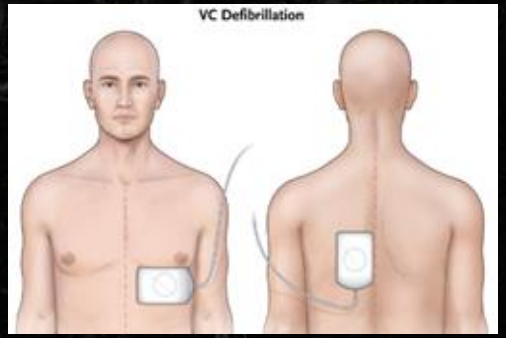


VECTOR CHANGE



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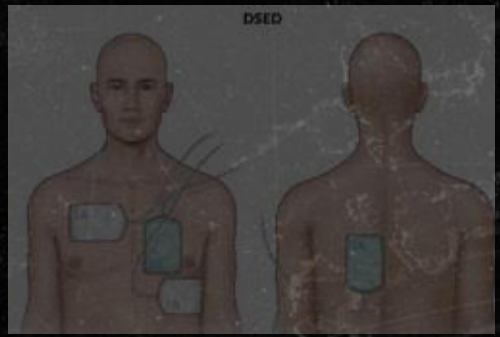

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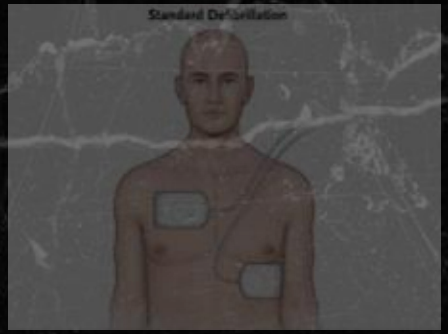

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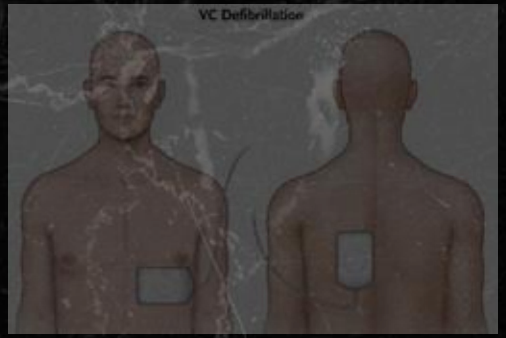

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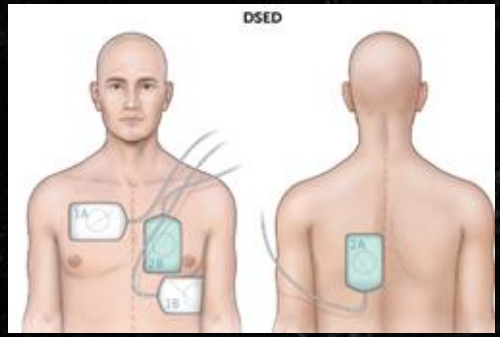


Caution!

Ensure pads not touching

Don’t cross the cables

Dual Dose Defibrillation:

Two defibrillators deliver simultaneous shocks.

NOT recommended (concerns of myocardial injury, defib damage.

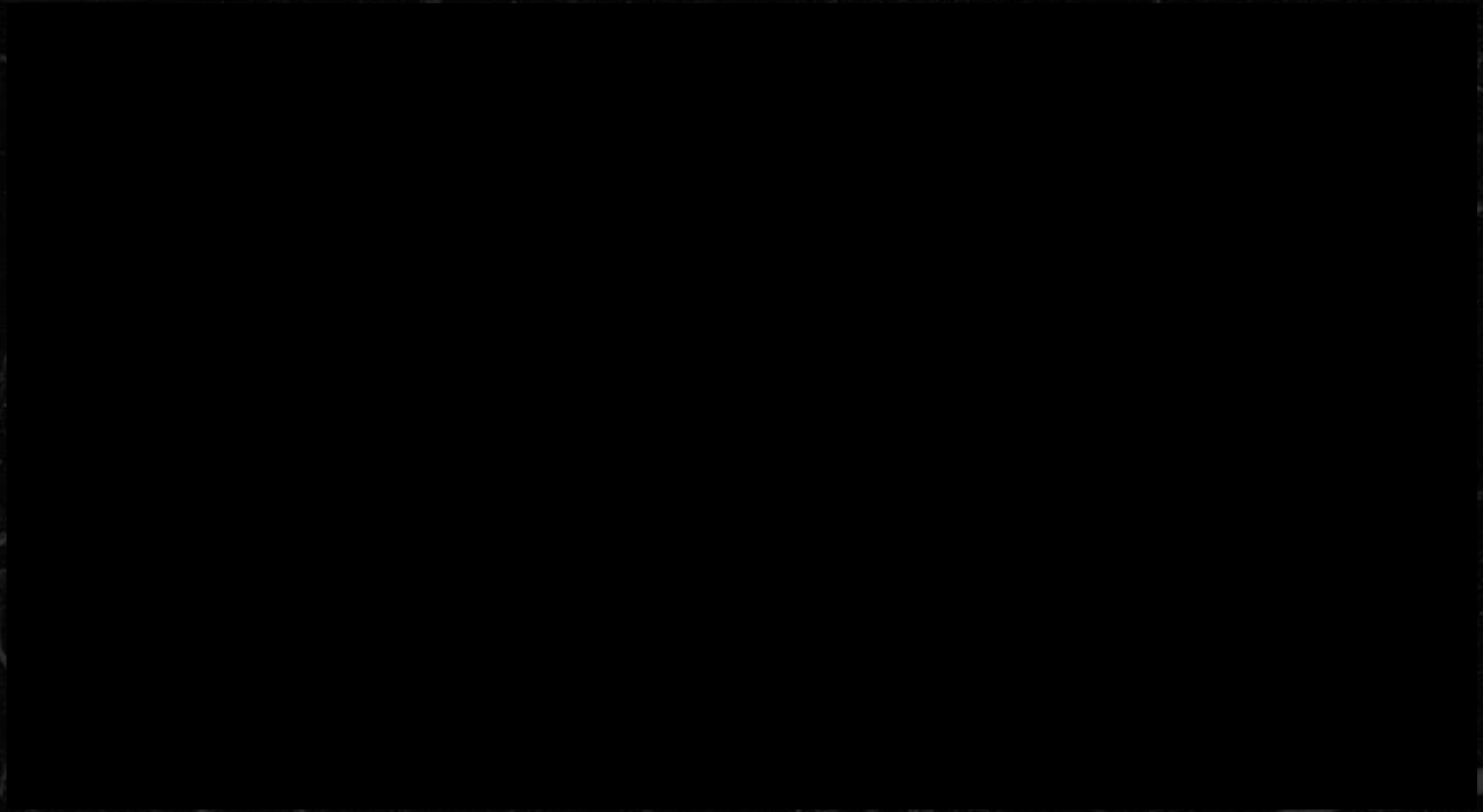
06

Procedure

Everything is the same… until you make one decision that isn’t in the algorithm!

One person charges and defibrillates in quick sequential order

Or…



07

The Research

AHA 2025 Guidelines:

“The usefulness of vector change (VC) and double sequential defibrillation (DSD) has not been established as therapies for shock-refractory ventricular fibrillation (VF); however, further investigation of these techniques, patient candidacy, and the development of new technology to optimize shock delivery are necessary.”

Defibrillation Strategies for Refractory Ventricular Fibrillation (DOSE VF RCT) - New England Journal of Medicine.

Published November 2022

Study period: March 2018 - May 2020

Ended early due to pandemic

Six paramedic services in Ontario, Canada

Total of 405 patients

Compared:

Standard defibrillation

Vector change defibrillation (VC)

Dual Sequence Defibrillation (DSD)

Excluded traumatic arrest, DNR

Average age 63.6 years

84.4% were men

58% received bystander CPR

What did they look for?

Termination of VF,

Survival to hospital discharge.

Discharge with good neurologic outcome (Modified Rankin Scale ≤ 2)

Outcome	Standard	Vector Change	Dual Sequence
Total Patients	136 (33.6%)	144(35.6%)	125 (30.9%)
Termination VF	92 (67.6%)	115 (79.9%)	105 (84%)
ROSC	36 (26.5%)	51 (35.4%)	58 (46.4%)
Survival to discharge	18 (13.3%)	31 (21.7%)	38 (30.4%)
Survival with good outcome	15 (11.2%)	23 (16.2%)	34 (27.4%)

Other Data	Standard	Vector Change	Dual Sequence
Bystander Witness Cardiac Arrest	82 (60.3%)	110 (76.4%)	83 (66.4%)
Bystander CPR Performed	74 (54.4%)	90 (62.5%)	71 (56.8%)
Median Response Time	7.4 min	7.4 min	7.8 min
Median time from initial call to first shock	10.2 min	10.4 min	10.2 min
Number shocks to first ROSC	5.5	5.3	5.7

Follow up study: “The impact of alternate defibrillation strategies on shock-refractory and recurrent ventricular fibrillation: a secondary analysis of the DOSE VF cluster randomized controlled trial. ”

Same authors of DOSE VF RCT

Took original data and looked at outcomes of recurrent VF, versus true shock-refractory vfib

Recurrent VF defined as “absence of VF for at least five seconds followed by recurrence of VF.”

Shock-refractory VF defined as “continuous VF before and after three shocks.”

Looked at which pad placement worked best

345 of original 405 patients

60 (17%) shock-refractory

285 (83%) recurrent VF

DSD showed significantly better survival and neurologic outcomes than standard defibrillation, especially in true shock-refractory VF.

DSD also favorable in recurrent VF, but results were less precise and confidence is lower.

VC improved VF termination but did not clearly improve survival compared with standard defibrillation.

DSD improved ROSC and neurologic outcomes and appears **superior overall**, in both shock-refractory and recurrent VF.

VC improved VF termination but did not clearly improve survival vs standard defibrillation;

VC reasonable alternative when DSD is not feasible.

08

How Does DSD Work?

Power Hypothesis:

Two sequential shocks may deliver a combined energy that a single shock can’t achieve.”

Priming Theory:

First shock may lower myocardial resistance, allowing the second to more effectively depolarize myocardium (one-two-punch)

Multi-Vector Theory:

Dual pad positions apply energy through different planes, increasing the chance of disrupting reentrant circuits in VF.

Improved Myocardial Engagement:

Captures more heart muscle and may bypass directional resistance caused by myocardial injury

09

Why This Lecture?

“Under pressure, you don’t rise to the occasion; you sink to the level of your training.”

Greek Poet Archilochus & Navy SEAL Mantra

Refractory VF is rare, but real

- Incidence - 0.5 to 0.6 per 100,000
- Mortality of up to 97%

DSD/VC defib to say, “We tried everything.”

Teamwork

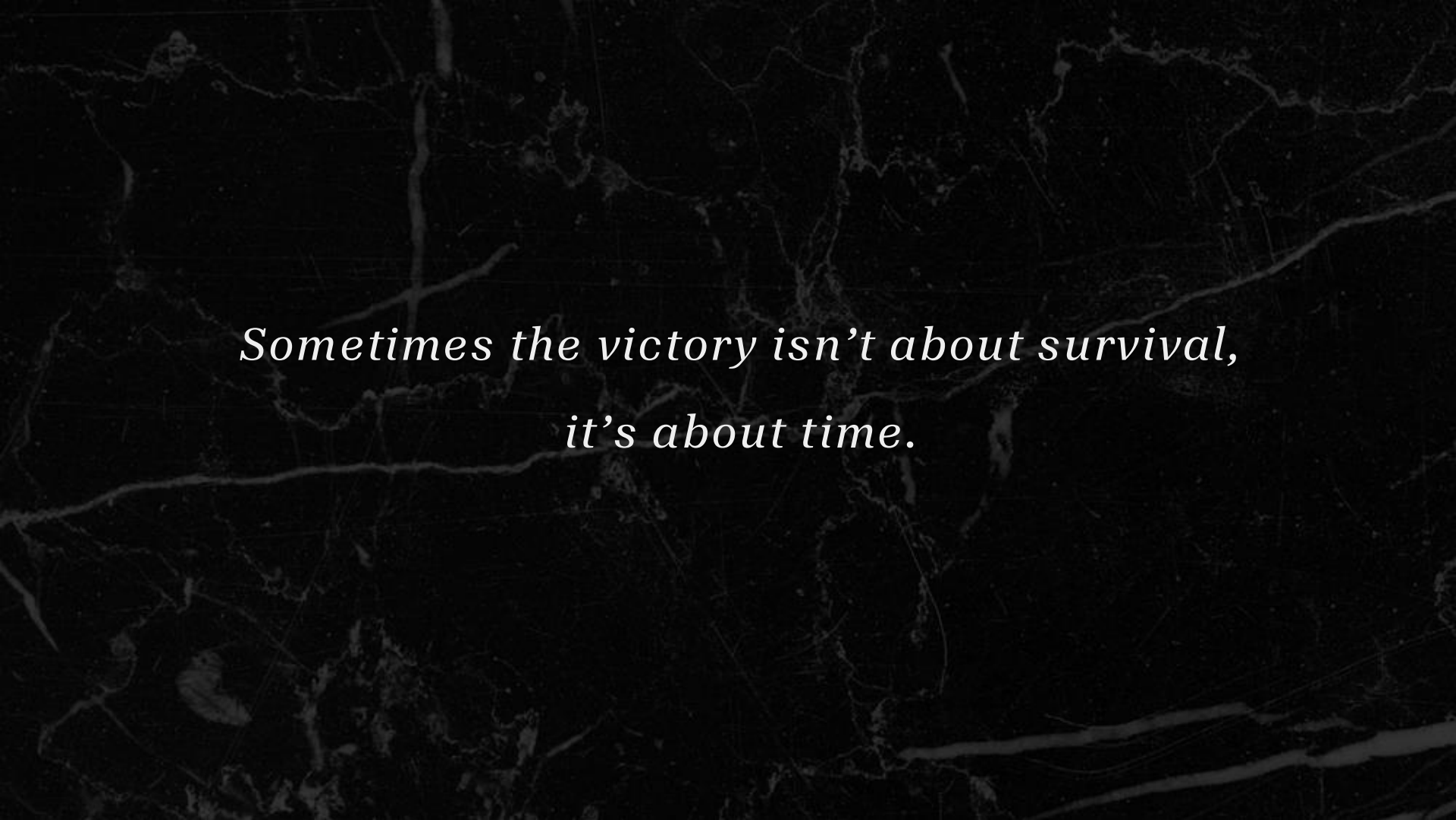
Nurses have a voice – use it!

Keep updated and an open mind on the current literature

EBP can prove and disprove a theory simultaneously.

“[We] gave the family a chance to say goodbye.”

Dr. Nick Vizzuso


Sometimes the victory isn’t about survival,
it’s about time.

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References

Additional Reading

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https://www.resuscitationjournal.com/article/S0300-9572(20)30104-0/fulltext

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https://coreem.net/core/dual-sequential-defibrillation/

https://www.sciencedirect.com/science/article/pii/S0022073625001748

https://first10em.com/double-sequential-defibrillation-the-dose-vf-trial/

https://www.icureach.com/post/should-we-change-the-defibrillation-techniques-in-out-of-hospital-cardiac-arrest

https://www.communityheartbeat.org.uk/defibrillators-brief-history

Slide 1 (picture): I will not put hot sauce in the CPR dummy. BartsBlackboardcom. (n.d.). https://www.bartsblackboard.com/i-will-not-put-hot-sauce-in-the-cpr-dummy/season-20/915/

Slide 5 (video): https://www.youtube.com/watch?v=BKP3Qe_zZ18

Slide 14 (video): https://www.youtube.com/watch?v=5sxRGSFEP30

Slide 23 (picture): 1947 Defibrillator. (n.d.). https://commons.wikimedia.org/wiki/File:1947_defibrillator.jpg#Summary.

Slide 23: Verkaik, B. J., Walker, R. G., Marx, R., Ekkel, M. M., Taylor, T. G., Stieglis, R., van Eeden, V. G., van Schuppen, H., Chapman, F. W., & van der Werf, C. (2023). Abstract 419: Incidence of true refractory ventricular fibrillation in patients meeting a pragmatic definition of refractory ventricular fibrillation. Circulation, 148(Suppl_1). https://doi.org/10.1161/circ.148.suppl_1.419

Slide 26: Cheskes, S., & McLeod, S. L. (2025). Double sequential external defibrillation for refractory ventricular fibrillation: The science, the controversies and the future. *Journal of Electrocardiology*, *91*, 154046. https://doi.org/10.1016/j.jelectrocard.2025.154046

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Slide 49: Cheskes, S., Drennan, I. R., Turner, L., Pandit, S. V., & Dorian, P. (2024). The impact of alternate defibrillation strategies on shock-refractory and recurrent ventricular fibrillation: A secondary analysis of the DOSE VF cluster randomized controlled trial. Resuscitation, 198, 110186. https://doi.org/10.1016/j.resuscitation.2024.110186

Slide 55, 56, 57, 58: Cheskes, S., Drennan, I. R., Turner, L., Pandit, S. V., & Dorian, P. (2024). The impact of alternate defibrillation strategies on shock-refractory and recurrent ventricular fibrillation: A secondary analysis of the dose VF cluster randomized controlled trial. Resuscitation, 198, 110186. https://doi.org/10.1016/j.resuscitation.2024.110186

Slide 60: Verkaik, B. J., Walker, R. G., Marx, R., Ekkel, M. M., Taylor, T. G., Stieglis, R., van Eeden, V. G., van Schuppen, H., Chapman, F. W., & van der Werf, C. (2023a). Abstract 419: Incidence of true refractory ventricular fibrillation in patients meeting a pragmatic definition of refractory ventricular fibrillation. Circulation, 148(Suppl_1). https://doi.org/10.1161/circ.148.suppl_1.419