



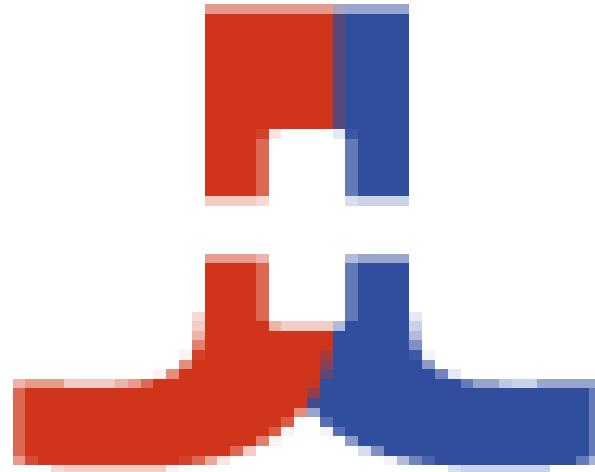
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Conquering Refractory Ventricular Fibrillation in the Prehospital & Emergency Department Setting

Andrew J. Bowman
Acute Care Nurse Practitioner
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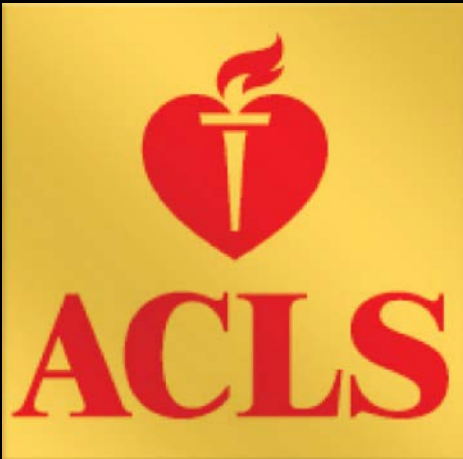



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Janus
GENERAL HOSPITAL

Emergency Department



ADVANCED CARDIOVASCULAR LIFE SUPPORT		ADVANCED CARDIOVASCULAR LIFE SUPPORT	
ACLS Provider	 American Heart Association®	Training Center Name	TC ID #
		TC Info City, State ZIP	TC Phone
This card certifies that the above individual has successfully completed the cognitive and skills evaluations in accordance with the curriculum of the American Heart Association Advanced Cardiovascular Life Support (ACLS) Program.		Course Location	Instructor Name
Issue Date	Recommended Renewal Date	Inst. ID #	Holder's Signature
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OHCA



Recognition and activation of the emergency response system

Immediate high-quality CPR

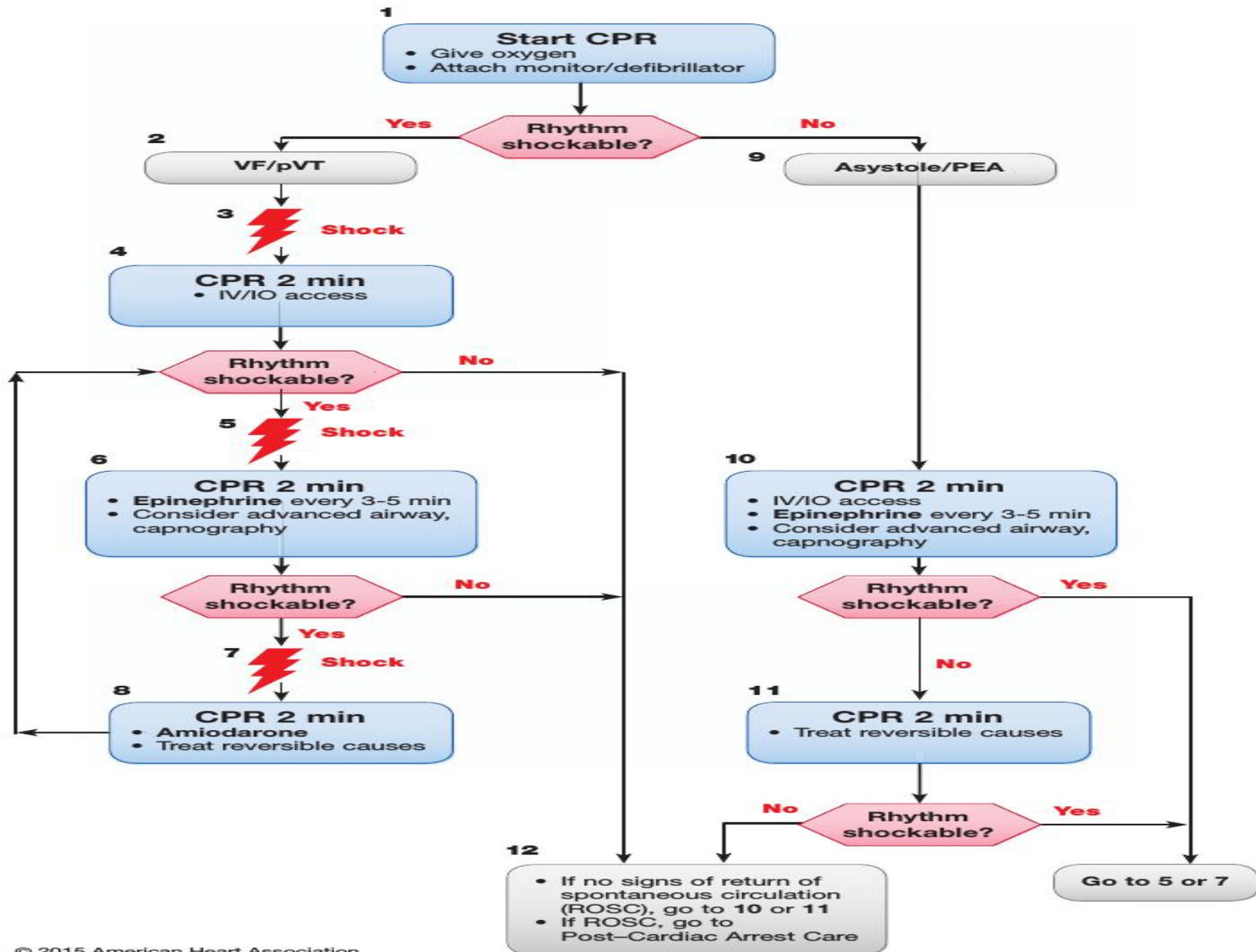
Rapid defibrillation

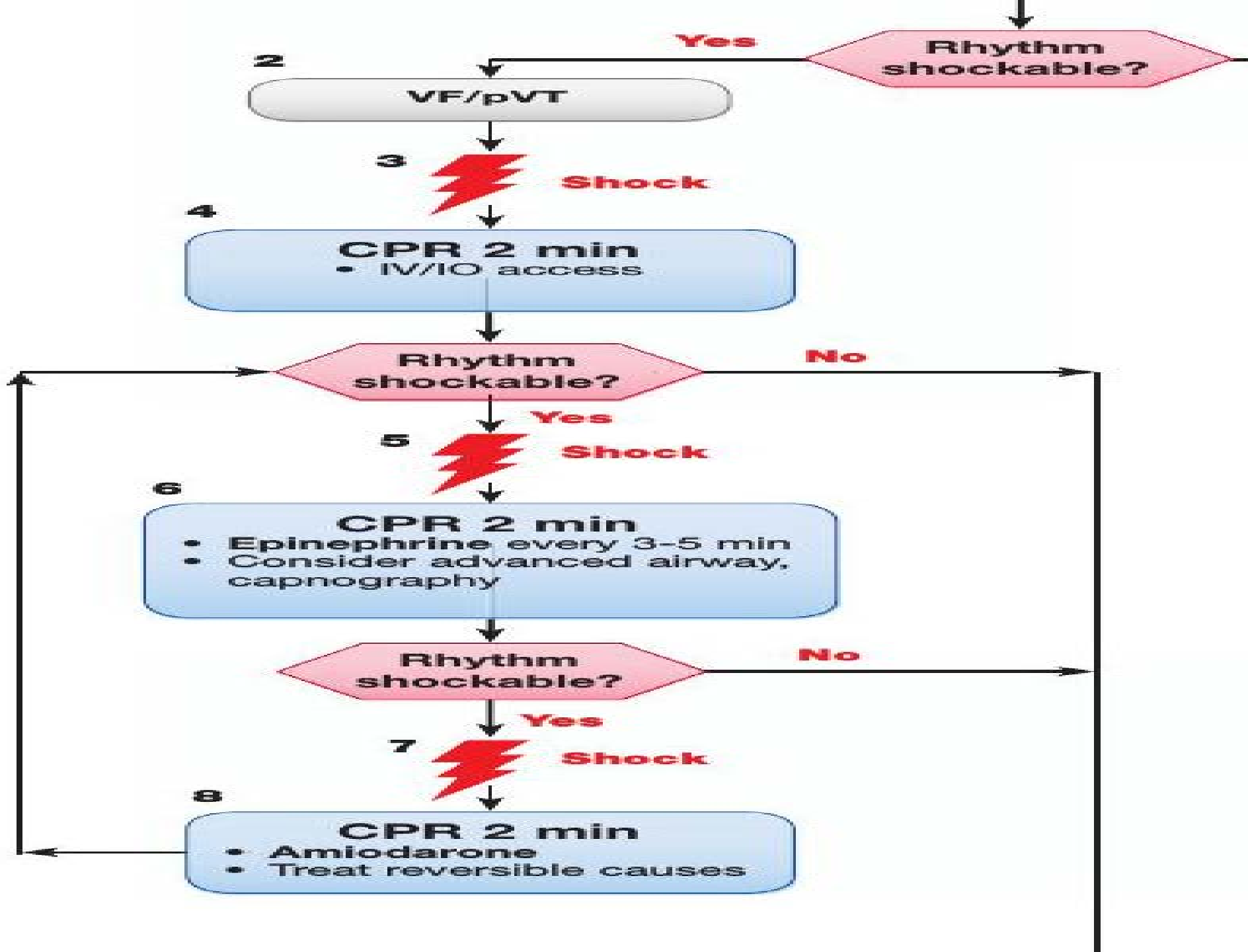
Basic and advanced emergency medical services

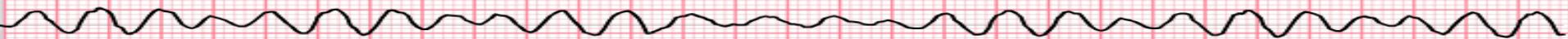
Advanced life support and postarrest care



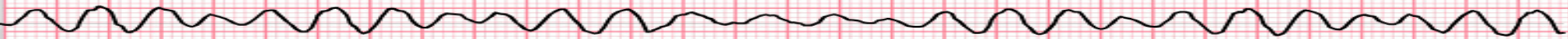
Adult Cardiac Arrest Algorithm – 2015 Update



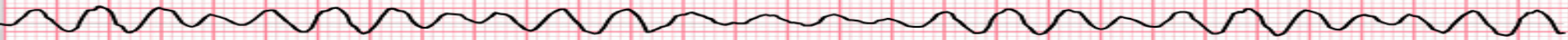




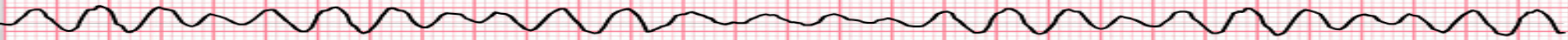
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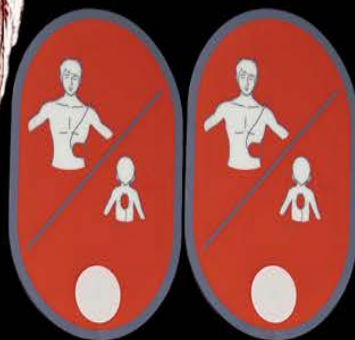
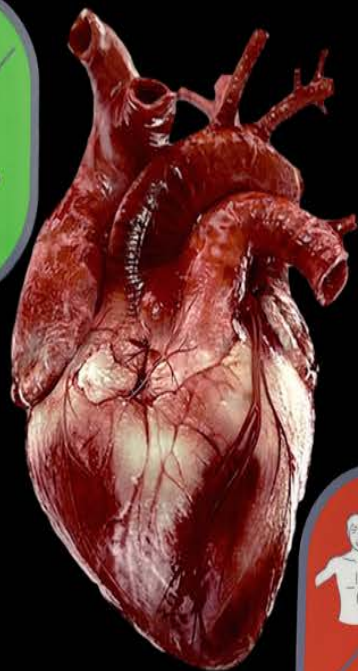
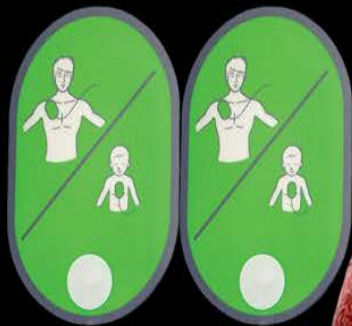
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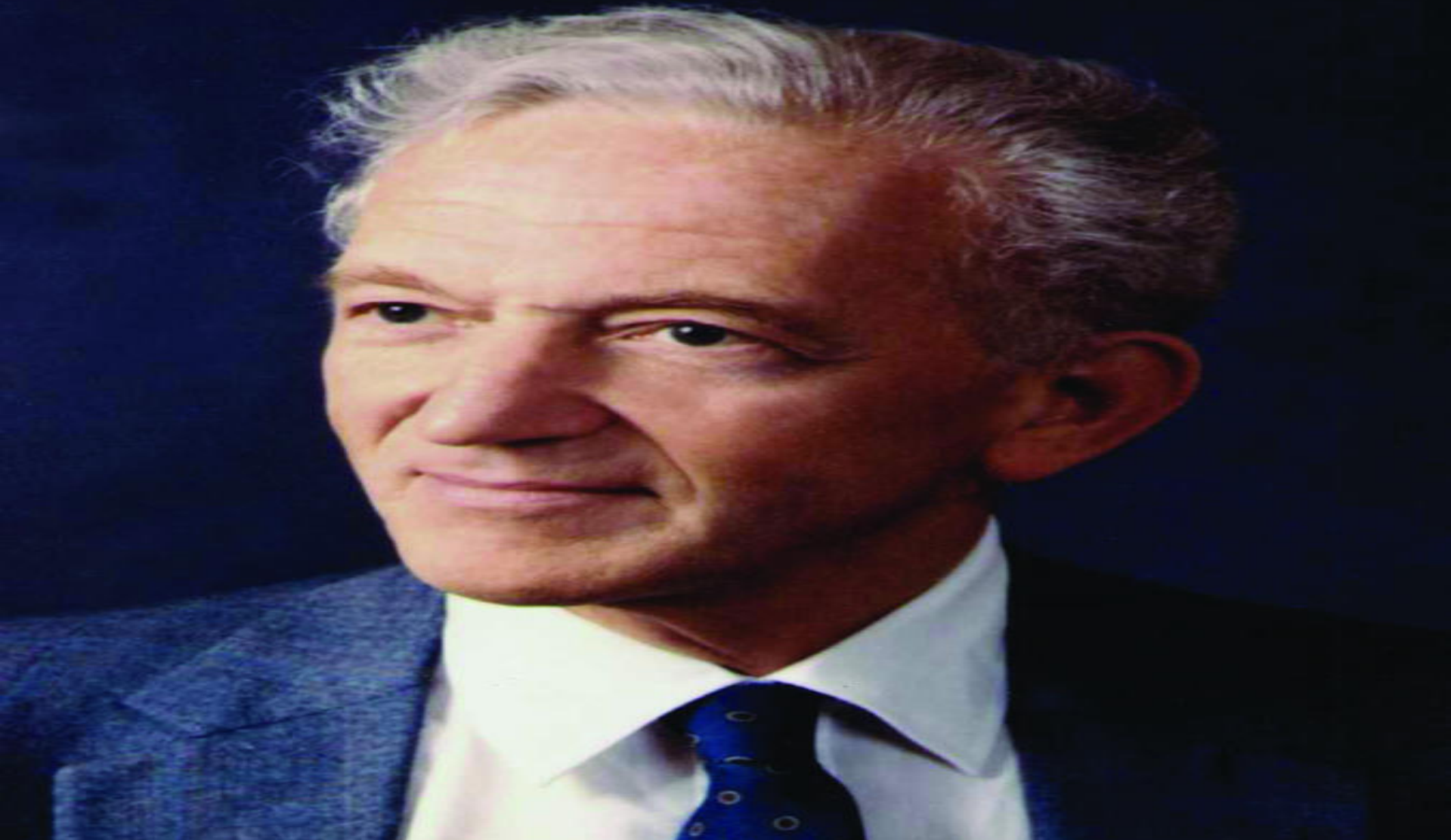
Strategies for Refractory VF

Strategies	Effect
High performance CPR	Optimize blood flow
Defibrillation	Optimize Defibrillation
Vasopressors	? Epinephrine
Antiarrhythmics	ALPS Study
Fix the Ischemia	Definitive Treatment for Ischemic VF
ECMO	Keep alive until fix ischemia



Dual
Sequential
Defibrillation
(DSD)

Esmolol



**“for the person with a heart and brain
too good to die.”**

Date	Author	Subject	Conclusion
1986	Chang	Canine	<p>Both healthy and induced infarcted canine hearts with induced VF</p> <p>DSD shock terminated if single shock did not</p>
1986	Jones	Human	<p>21 <u>healthy volunteers</u> underwent induced VF in EP lab to single or double sequential defibrillation</p> <p>DSD had lower defibrillation threshold, patients with repeated failed single shocks at max voltage had immediate successful DSD as "rescue"</p>
1989	Brady	Human	<p>16 OOHCA survivors were randomized and demonstrated lower defibrillation threshold with DSD</p>
1994	Hoch	2,990 EP lab patients	<p>5 patients with refractory VF resistant to single shocks.</p> <p>All 5 VF terminated with first DSD shock</p> <p>All 5 survived</p>

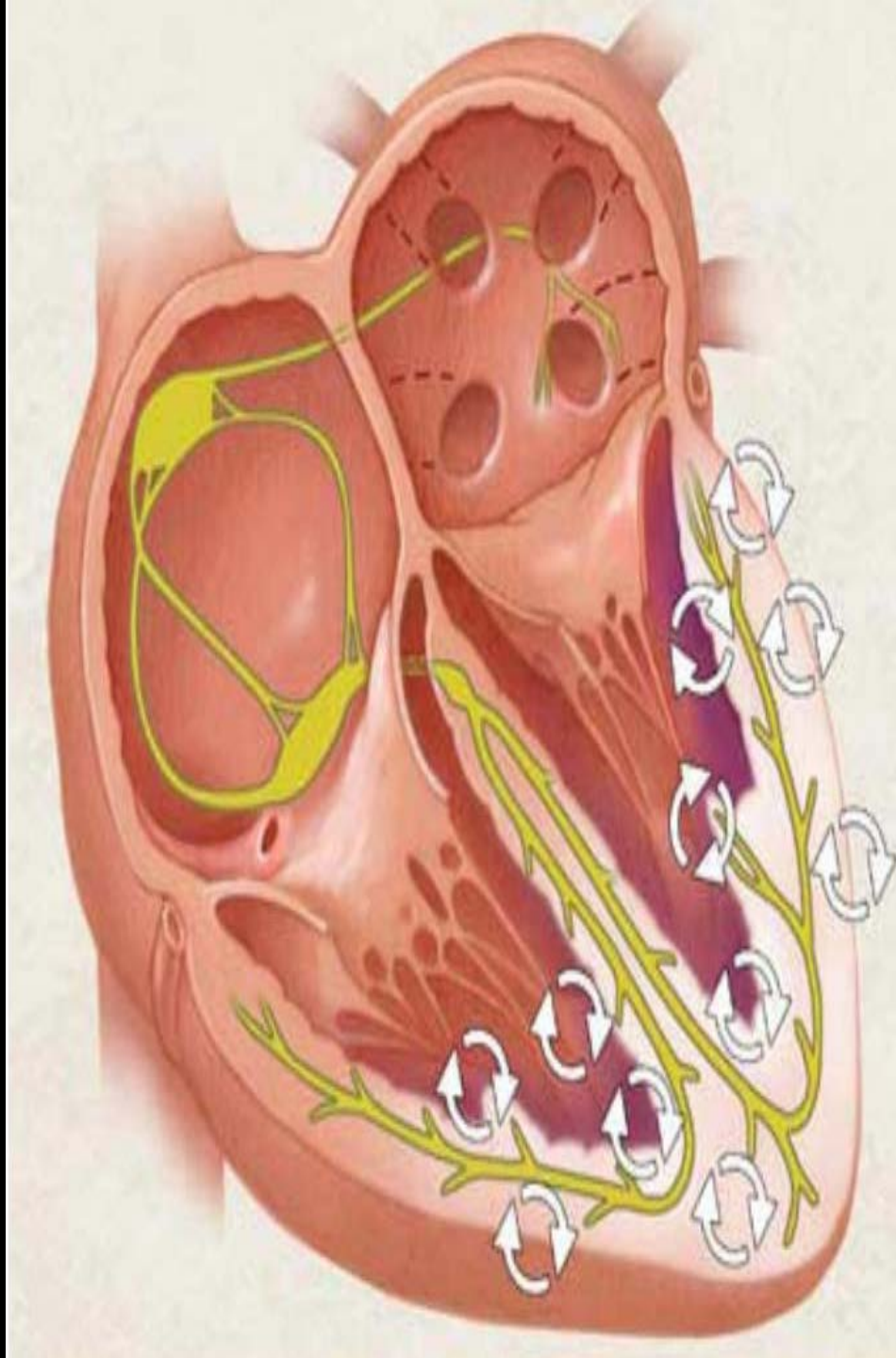
Date	Author	Subject	Conclusion
2014	Cabanas	OOHCA 10 patients	Successful conversion to NSR in 7/10 patients Unfortunately no survivors
2014	Gerstein	DSD IHCA	Successful DSD defibrillation after 74 minutes of resuscitation
2015	Lybeck	40 yo OHCA with VF from commotio cordis	DSD on 8th attempt CT cardiac contusion. Normal coronaries on cath. DC with full neurological function
2016	Bowman	21 yo with SAD	DSD on 8th defibrillation attempt Conversion to SR Cath -> normal coronaries DC with CPC 1, back to college, AICD

Date	Author	Subject	Conclusion
2016	Johnston	28 yo OHCA	CPR 6 single shocks 1 DSD w ROSC Dx w LQT, AICD, CPC 2
2016	Ross	3 Years 3470 OHCA	302 refractory VF 279 complete data 50 DSD, 229 No DSD No significant survival difference
2016	Cortez	4 Years 2428 OHCA	12 DSD 9 converted out of VF 3 ROSC 2 w CPC 1
2016	Jui	Prospective Study	28 patients 12 w conversion from VF 9 w ROSC 3 survivors w CPC 1-2 (ages 27-81)



Dual Sequential Defibrillation

- Possible larger current density and more even distribution over myocardium
- More myocytes depolarized
- Prolonged shock duration depolarizing more myocytes
- More energy



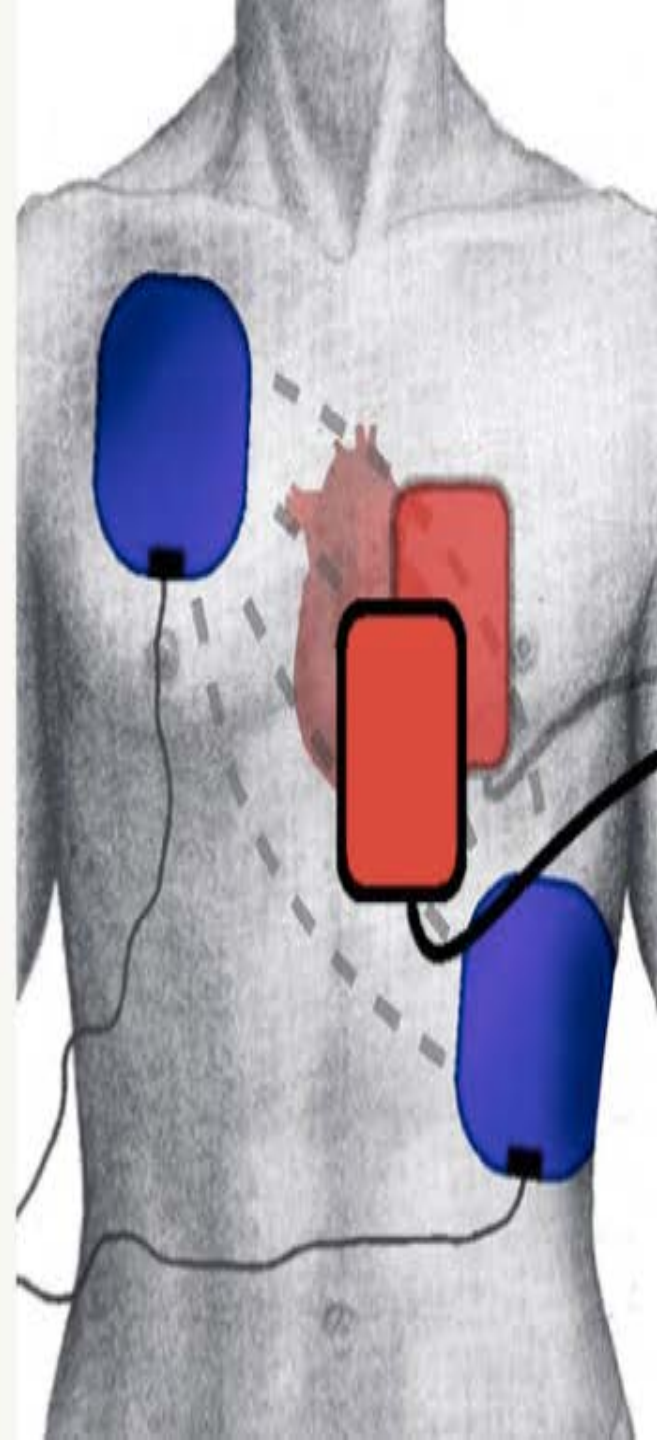
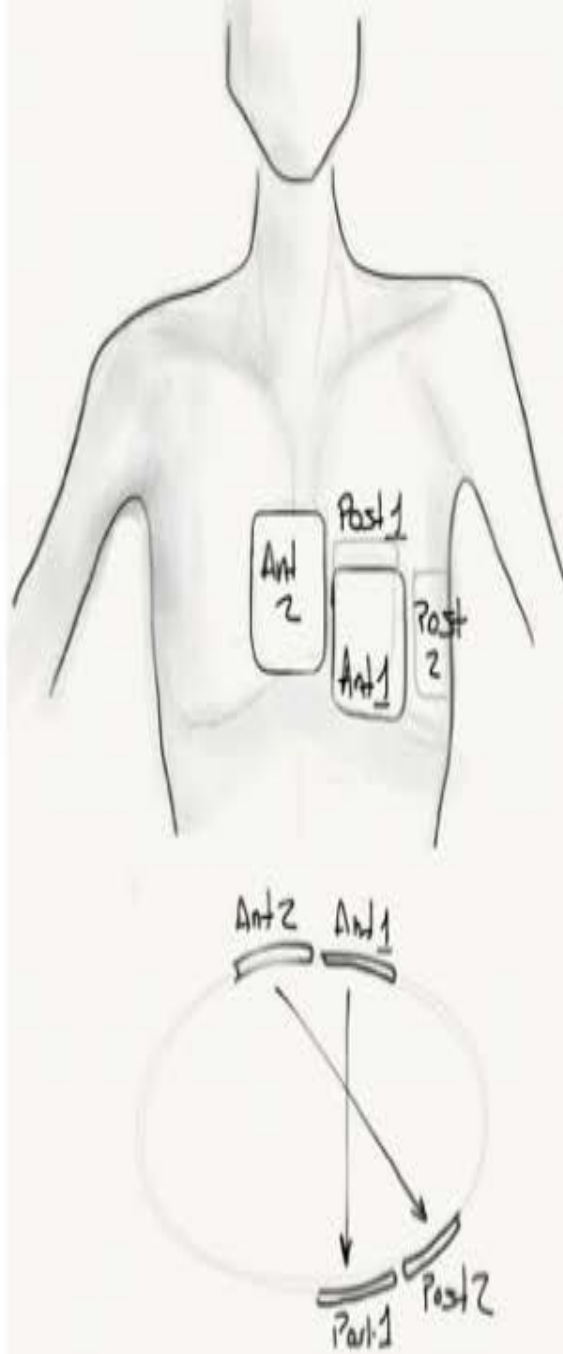
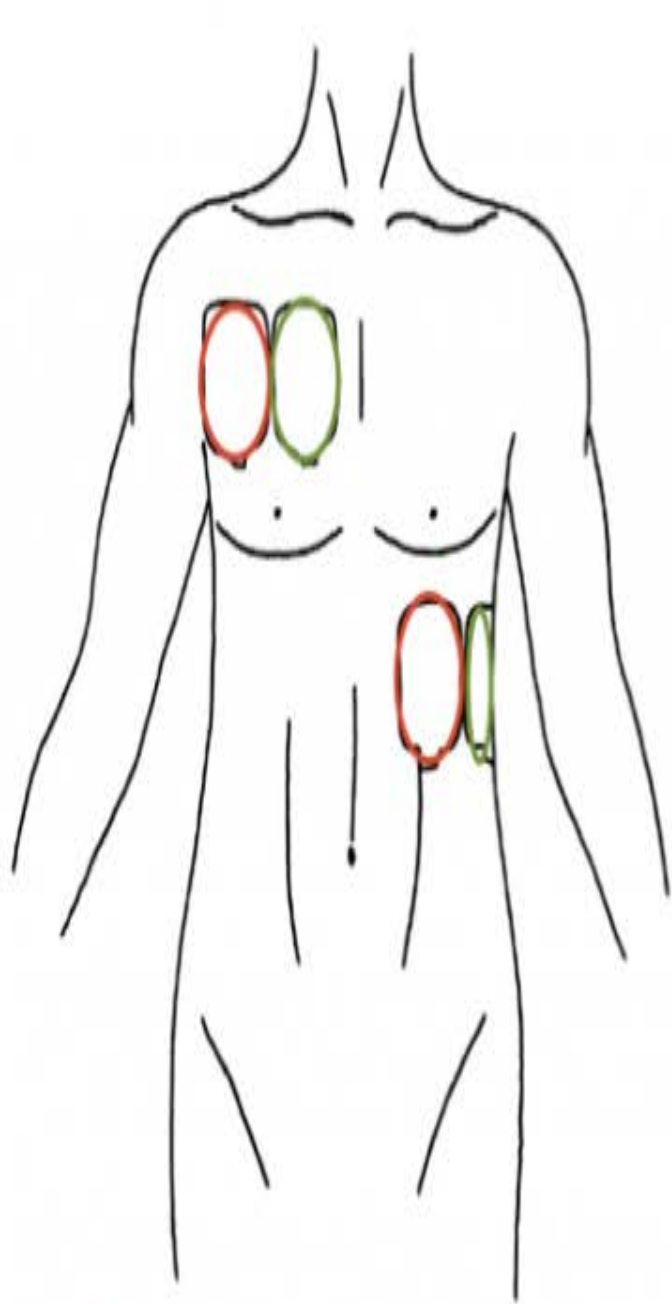
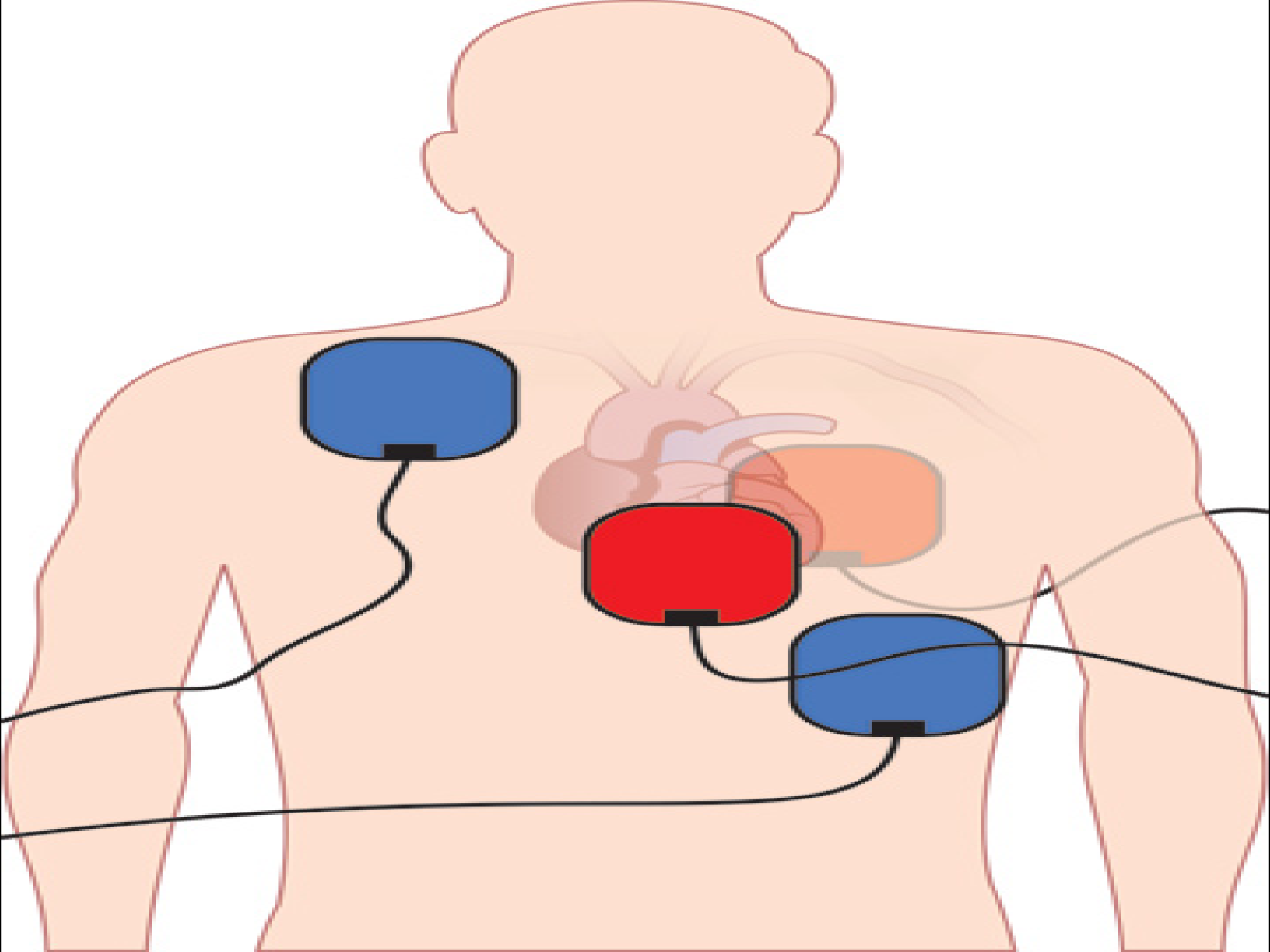


Figure 1. Placement of defibrillator pads.



Double Sequential Defibrillation – Adult

6.1

PARAMEDIC STANDING ORDERS – ADULT

INDICATION: Refractory Ventricular Fibrillation / Tachycardia after 5 unsuccessful shocks

- **Recurrent ventricular fibrillation/tachycardia** is defined as **SUCCESSFULLY CONVERTED** by standard defibrillation techniques but subsequently returns. It should **NOT** be treated by double sequential external defibrillation. It is managed by treatment of correctable causes and use of anti-arrhythmic medications in addition to standard defibrillation
- **Refractory ventricular fibrillation/tachycardia** is defined as **NOT CONVERTED** by standard defibrillation. It is initially managed by treating correctable causes and with antiarrhythmic medications. If these methods fail to produce a response, double sequential external defibrillation may be beneficial.

PROCEDURE:

1. Prior to attempting Double Sequential Defibrillation, at least one shock should be given using a different vector. Change pad placement from anterior-apex to anterior-posterior.
2. Ensure quality CPR and minimally interrupted chest compressions during pad application and procedure.
3. Apply a new set of external defibrillation pads adjacent to, but not touching the pad set currently in use.
4. Assure that controls for the second manual defibrillator are accessible to the team leader
5. Verify that both cardiac manual defibrillators are attached to the patient, that all pads are well adhered, and simultaneously charge both manual defibrillators.
6. When both monitors are charged to maximum energy settings and all persons are clear, push both shock buttons as synchronously as possible.
7. May repeat procedure every 2 minutes as indicated if refractory ventricular fibrillation/tachycardia persists

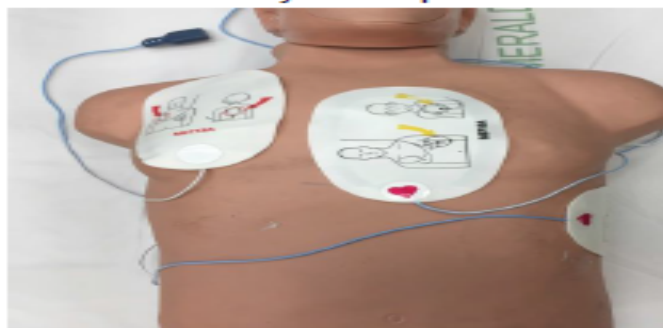


Photo Courtesy of Emergency Medicine Reviews and Perspectives

PEARLS

- Continue compressions when defibrillators are charging.
- During interruptions compressor's hands should hover over chest.
- Pre-charge manual defibrillators prior to rhythm check to ensure rapid defibrillation if a shockable rhythm is present. If no shock is indicated, disarm the device (dump the charge)
- Depending your local hospital resources, some refractory ventricular fibrillation patients may benefit from emergent cardiac catheterization. For this small patient population, transportation (ideally with a mechanical CPR device) may be indicated. Transporting these patient directly to the cath lab should be done in collaboration with on-line medical control and interventional cardiology.

P



**ESMOLOL
HCl INJECTION**

FOR IV USE

100 mg/10 mL

(10 mg/mL)

Rx ONLY.

Refractory VF Treated with Esmolol

- Lee et al
- Resuscitation October 2016
- 41 patients
- OHCA with refractory VF
- 25 No Esmolol
- 16 Esmolol
- Load 500mcg
- Infusion 0 – 100mcg/kg/min

	Esmolol	No Esmolol
# Patients	16	25
Sustained ROSC	56.3%	16%
Survive to ICU	56.3%	16%
Survive 30d	18.8%	8%
Good Neuro 30d	18.8%	8%
3mo Survive	18.8%	8%
Good Neuro 3mo	18.8%	8%

Esmolol After Failure Standard CPR with Refractory VF

- **Driver et al**
- **Resuscitation October 2014**

- **25 patients**
- **19 No esmolol**
- **6 Esmolol**

Endpoint	Esmolol	No Esmolol
ROSC	67%	42%
Sustained ROSC	67%	32%
ICU Survival	66%	32%
DC Survival	50%	16%
Favorable Neuro DC	50%	11%

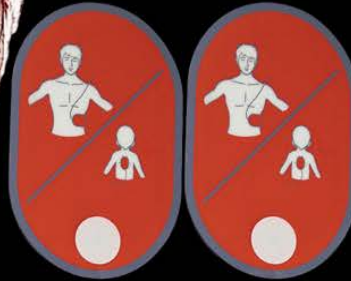
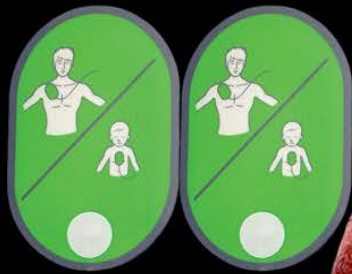
First Report of Survival in Refractory VF after DSD and Esmolol

- **Boehm et al**
- **November 2016**
- **Western Journal of Emergency
Medicine**

- **67 yom**
- **Hx LAD stent**
- **ED CP with CPA**
- **VF**

- **First 15 minutes**
 - **5 single shocks**
 - **Epi 1 mg x 4 doses**
 - **Amiodarone 450mg**

- **Decision to use DSD & Esmolol**
- **DSD x 1, no change**
- **Esmolol 80mg IVP (~1000mcg/kg)**
- **Esmolol 0.1mg/kg/hr (~133mcg/min)**
- **Circulated x 3 minutes**
- **2nd DSD with ROSC and waking up**
- **Cath lab with LAD lesion/stent**



Dual
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Defibrillation
(DSD)

Esmolol