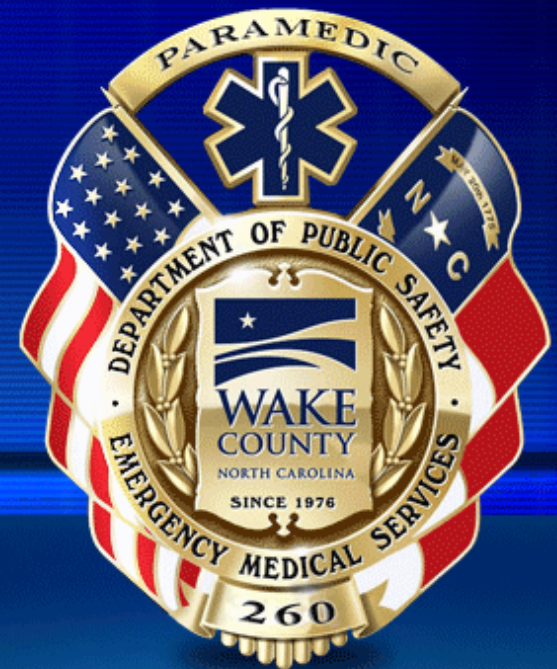


What To Do with Refractory Ventricular Fibrillation?

Brent Myers, MD MPH
Director
Wake EMS System, Raleigh, NC



“However beautiful the strategy, you should occasionally look at the results.”

-- Winston Churchill



The Plan

- ✚ Two Brief Case Reviews
- ✚ Review of the Evidence (and the Anecdote)
- ✚ A Modest Proposal



Case #1

- ✚ 82 year-old male
- ✚ Pseudo-witnessed cardiac arrest in his home
- ✚ No bystander CPR but FR arrival in <6 mins

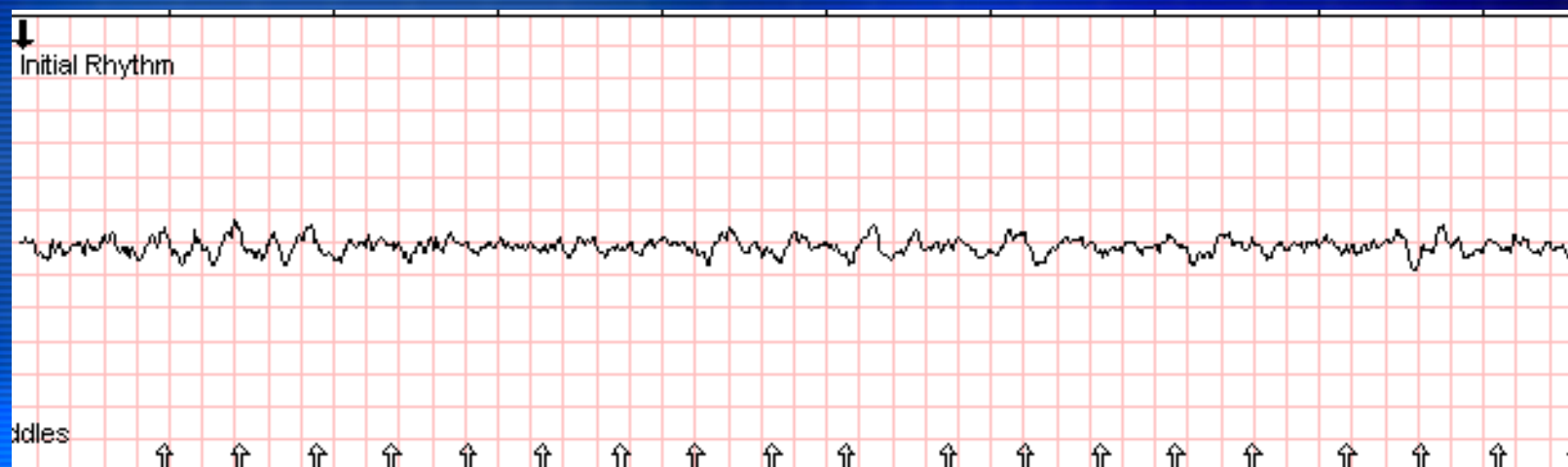


Case #1

- ✚ Firefighters begin uninterrupted compressions
- ✚ AED advised shock and one is delivered prior to EMS arrival



Case #1 Initial Rhythm

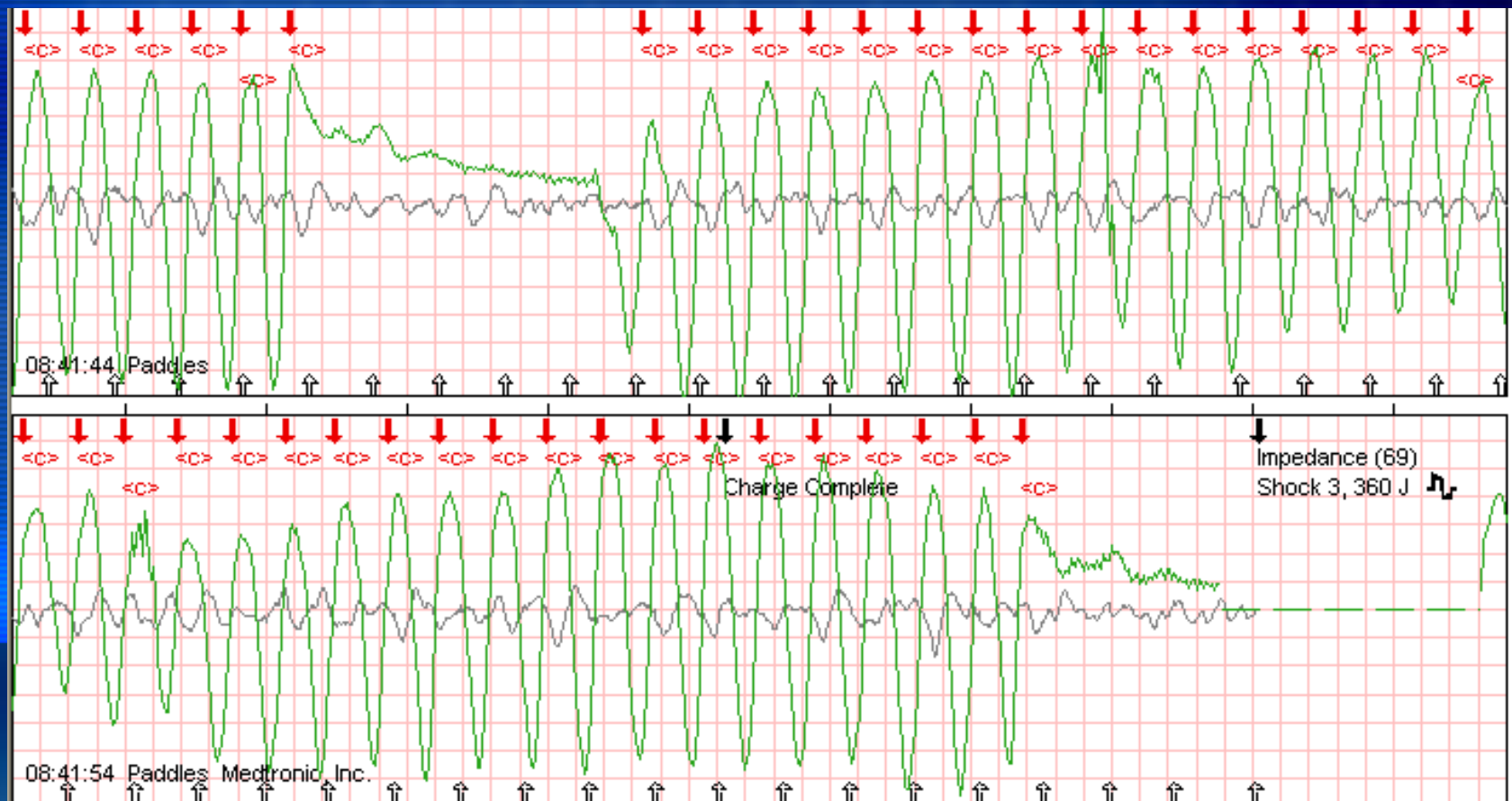


Case #1

- ✚ EMS arrives just as first defibrillation is being provided
- ✚ BVM EtCO₂ = 44 with good wave form
- ✚ IO is placed in tibia
- ✚ King Airway is placed
- ✚ Vasopressin and epinephrine are administered



Case #2 Third +10 mins

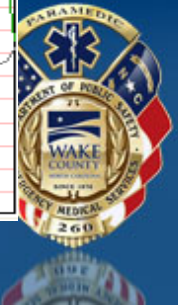


Case #2

- ✚ Bicarbonate, amiodarone, procainamide are administered
- ✚ Magnesium is also administered
- ✚ At ~ 25 minutes, EtCO₂ = 35



Case 1 Shock 7 +23 mins

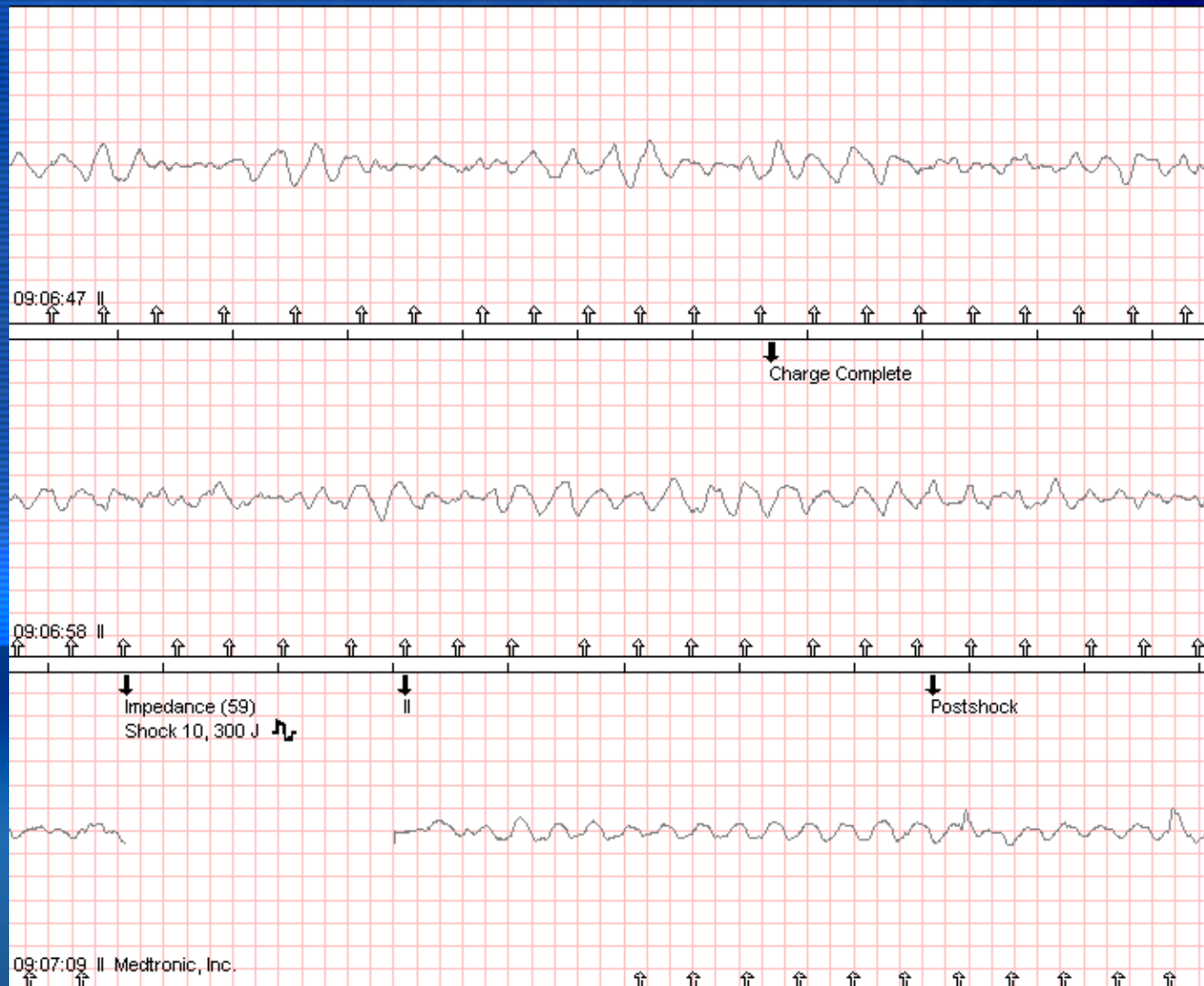


**Insanity: Doing the same thing
Over and over again and
Expecting different results**

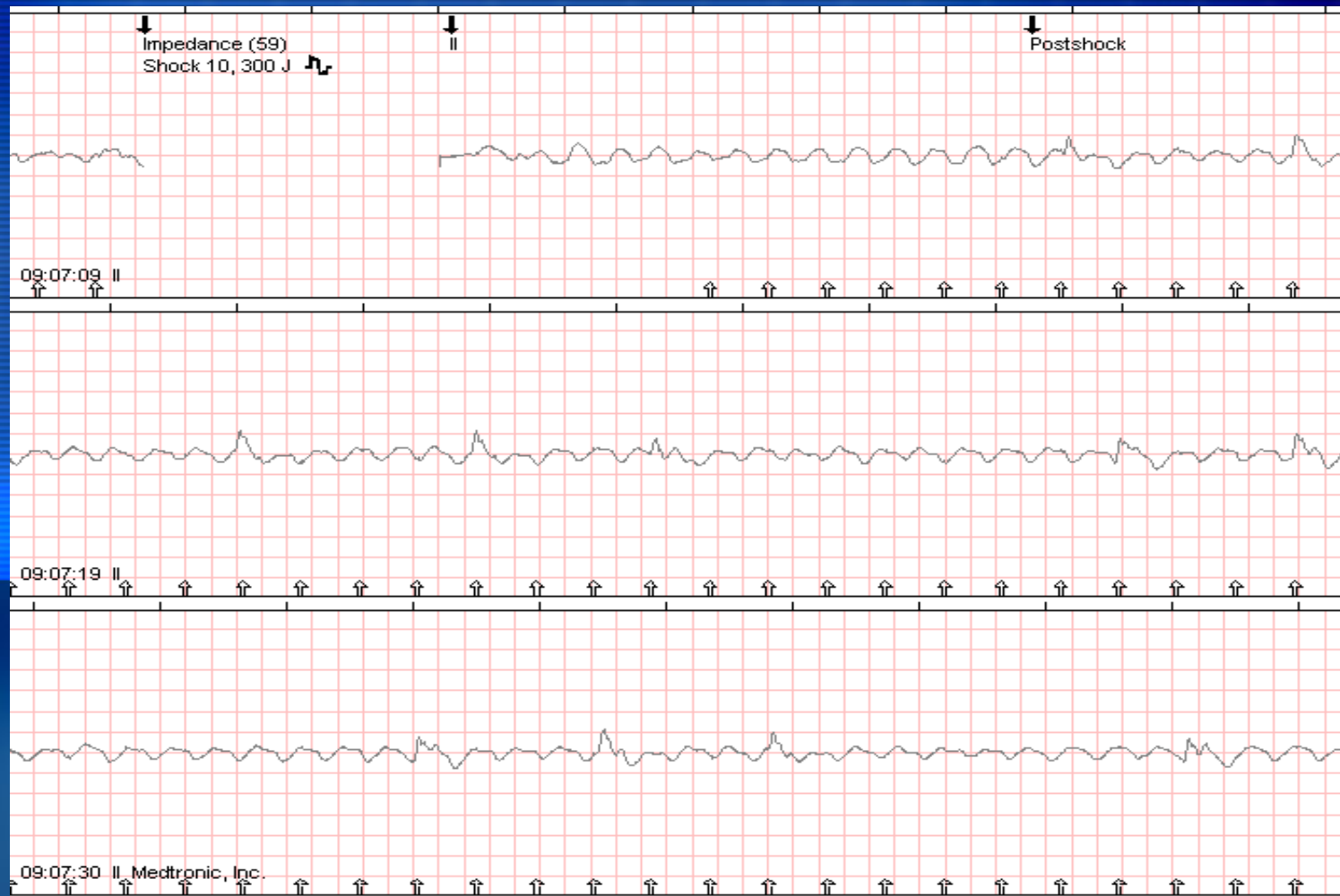
-Albert Einstein



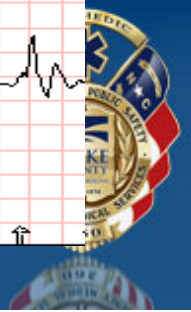
+36 mins First DSED



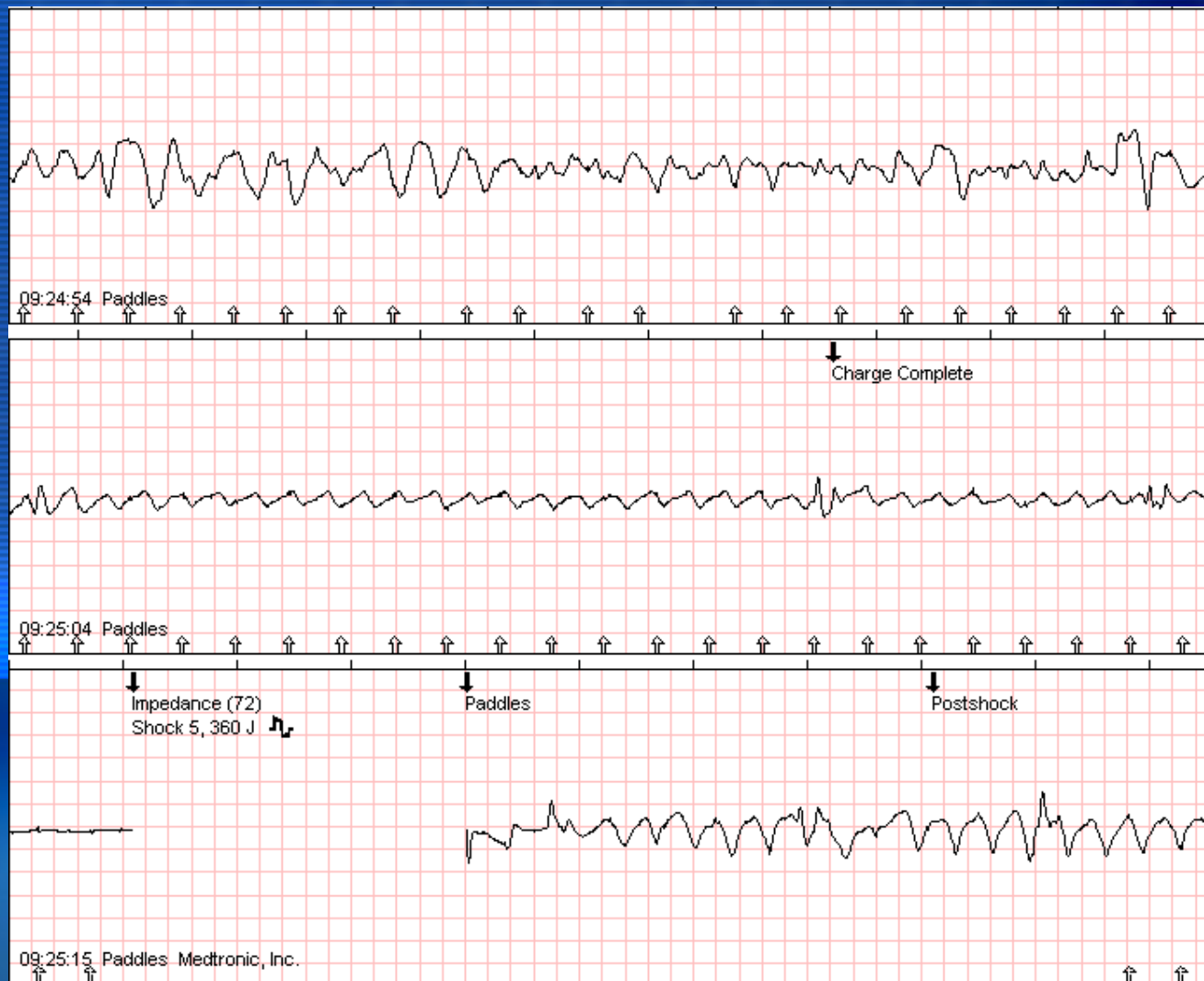
Case #1 DSED post-rhythm



Case #1 DSED #1 Monitor #2



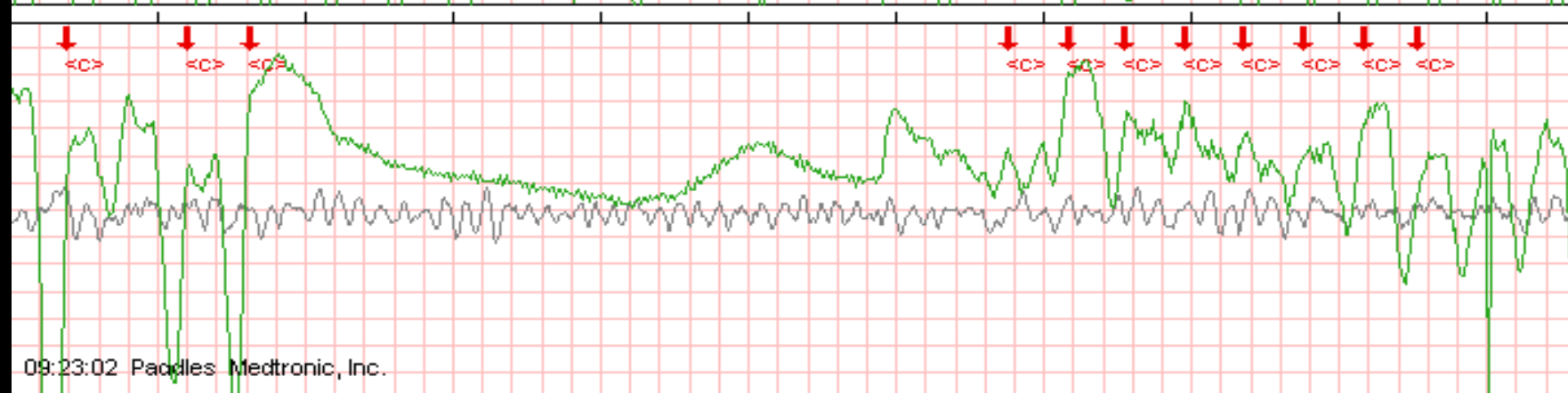
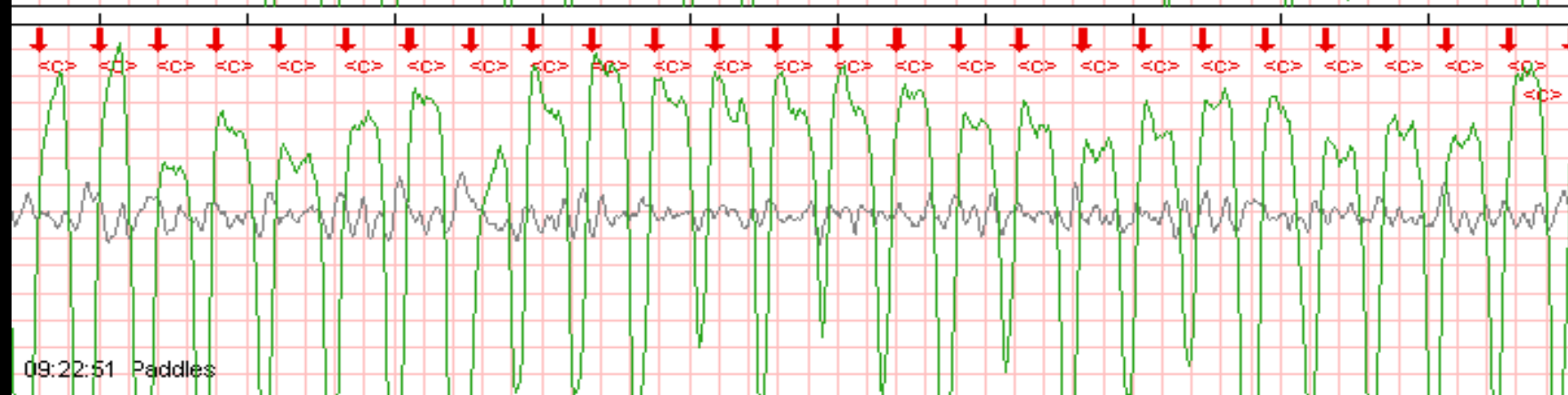
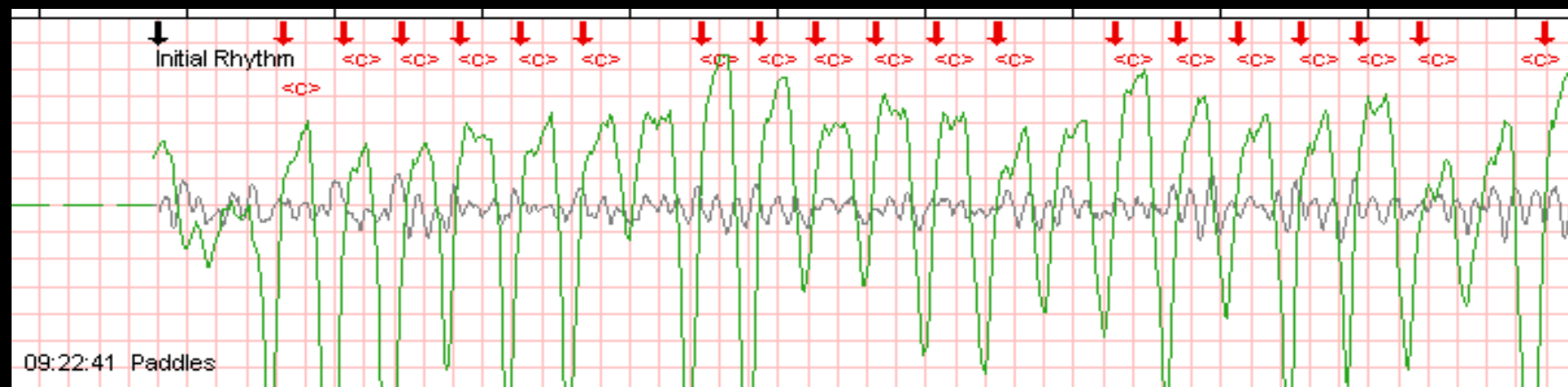
DSED 5, Shock 15 +56 mins



End of the Story

- ✚ Patient arrives in emergency department with EtCO₂ of 50 and good wave form
- ✚ After additional resuscitative efforts in the emergency department, work is terminated

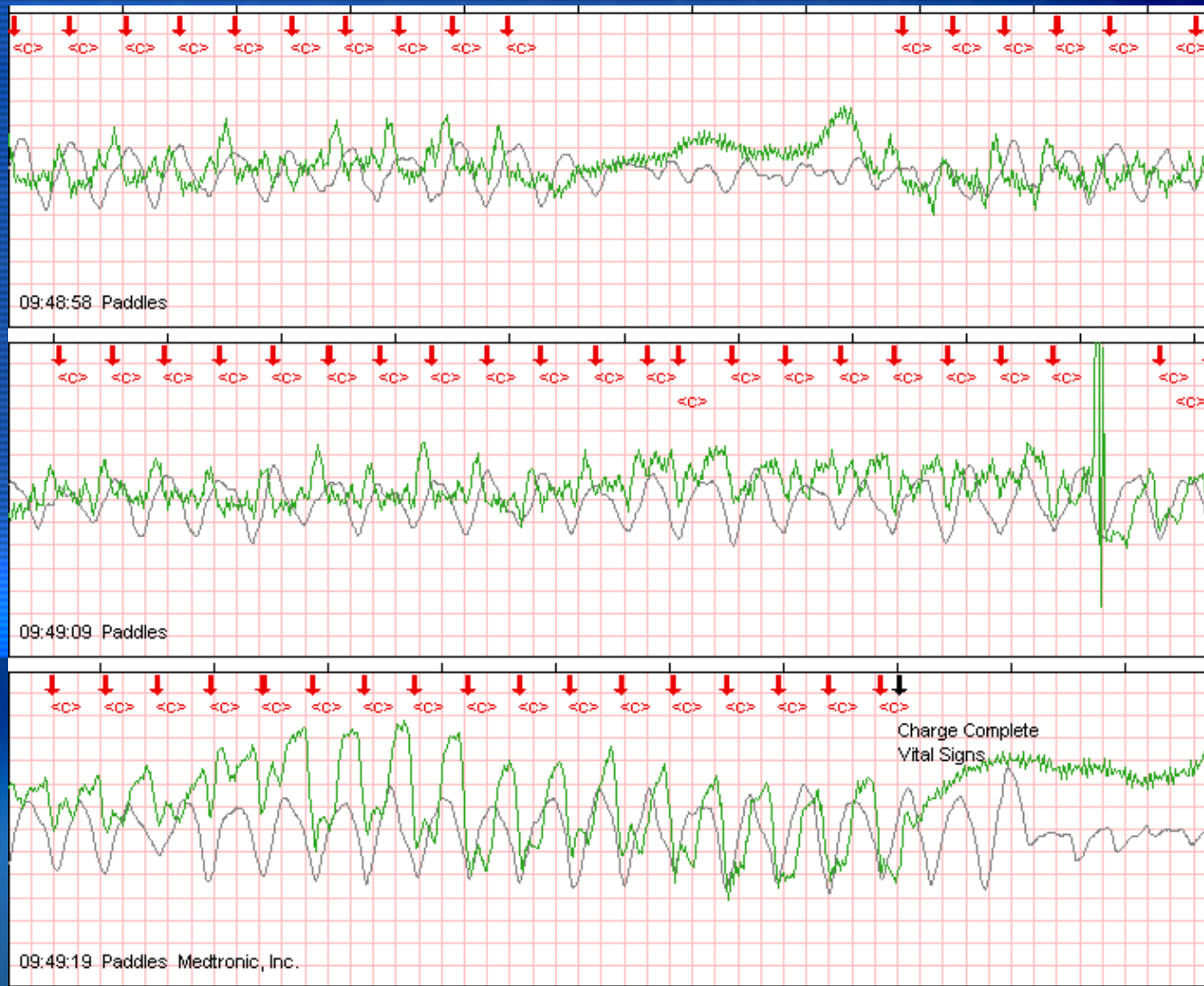




Case #2 First Shock at + 103 seconds



9th shock at + 27 mins



Vince's 12th shock, +38 mins (5 mins before transfer)



Follow-Up

- ✚ Patient achieved ROSC shortly after arrival in the community ED
- ✚ Witnessed by ED staff and wife, patient had purposeful movement in an attempt to remove his ETT
- ✚ Prior to transfer for PCI, patient suffered repeat ventricular fibrillation arrest and could not be resuscitated



A Little Evidence

✚ Observations:

- ✚ Refractory ventricular fibrillation is not new, particularly in the EP lab
- ✚ Current ACLS guidelines are superior to all previous ACLS guidelines
- ✚ The following discussion is “post-ACLS” and not “anti-ACLS”



There Are Five Things

- ✚ Electrical reversion at 200 wsec, 300 wsec, 360 wsec
- ✚ Intubation, hyperventilation, epinephrine
- ✚ Aggressive use of IV lidocaine with 360 wsec to follow
- ✚ Bretylium and magnesium IVP with 360 wsec to follow
- ✚ Repeat 360 wsec

✚ Slovis and Wrenn, J Critical Illness, 1994



 Apply non-rebreather with 1 or more OPA or NPA as soon as other care activities will not be interrupted

P



IO Procedure

P

I



Epinephrine 1 mg IV/IO repeat every 3-5 minutes

I

I



Vasopressin 40 U IV/IO

I



After 5 cycles of CPR check rhythm and pulse



Repeat **Defibrillation**

After defibrillation resume CPR without pulse check

P



Amiodarone 1st dose is 300 mg and may be repeated once at 150 mg.

P

P



Sodium Bicarbonate

P

I



Establish a secondary circulatory access point

I



After 5 cycles of CPR check rhythm and pulse



Repeat **Defibrillation**

After defibrillation resume CPR without pulse check

P



Magnesium Sulfate

P

I

Consider **Epinephrine** drip

I



Repeat **Defibrillation**

After defibrillation resume CPR without pulse check

P



Sodium Bicarbonate

P



Airway Protocol



Repeat **Defibrillation**

Pause 5 secs max to check rhythm/pulse, resume CPR



Recurrent – a Beta Blocker?

- ✚ The antiarrhythmic properties of beta blockade are often overlooked
- ✚ Like lidocaine, giving beta-blockade to prevent dysrhythmia or “clean up” PVCs in the ischemic heart appears unwarranted
- ✚ But what about “post-ACLS”?



Why Might This Work?

- ✚ Block the deleterious effects of beta stimulation from exogenous epinephrine and/or endogenous catecholamines
- ✚ “Membrane stabilization”
- ✚ Class II antidysrhythmic properties
 - ✚ Bourque D et al. Resuscitation 2007;75:434-444



Human Case Series

- ✚ 11 reports with 20 total observational patients in VF
- ✚ 17 patients with successful termination of VF (all 3 non-survivors in one series)
- ✚ 11 of 17 survived to discharge

Bourque D et al. Resuscitation 2007;75:434-444



Can We Reach a Conclusion?

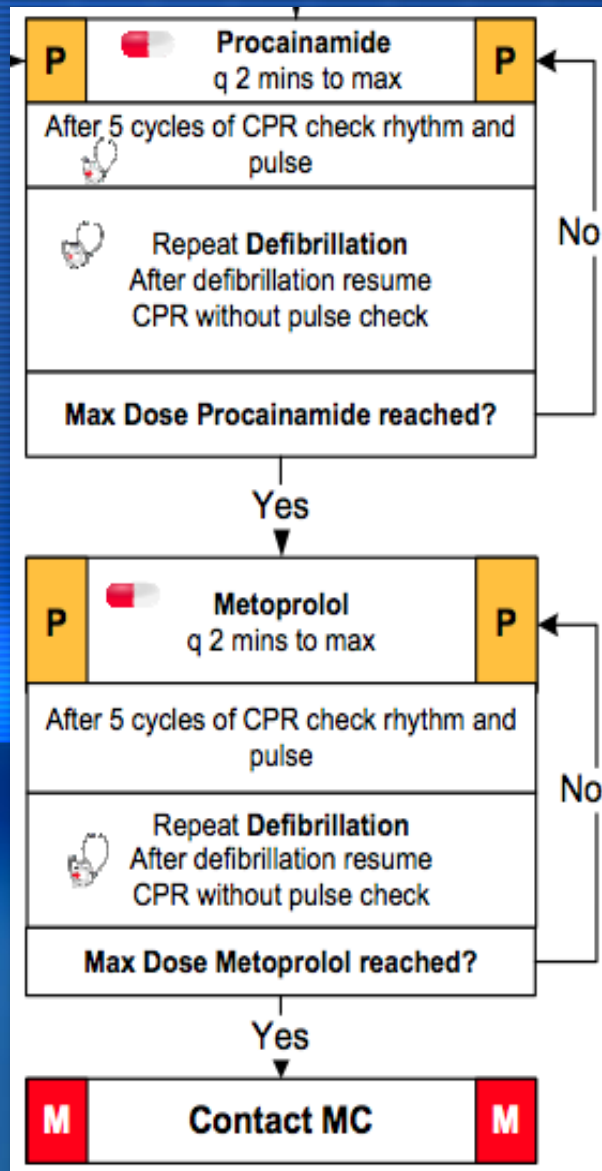
✚ NO

✚ Authors of literature review call for a randomized trial

✚ Meanwhile, we have individuals who are fibrillating “post-ACLS”



Recurrent Pathway



What About Persistent VF?

- ✚ Working hypothesis is that this is an electrical/mechanical problem
- ✚ Vectors, waveforms, and total energy each seem to play a role
- ✚ Not smart enough to talk about biphasic, reticulinear, etc.



What Evidence Do We Have?

✚ Atrial fibrillation patients

- ✚ Propofol and up to 2 “standard” single monitor/defibrillator cardioversions were provided from April 1998 and January 2003
- ✚ 99 patients failed to cardiovert after these 2 standard cardioversions
- ✚ They were enrolled in the study



What Evidence Do We Have?

- ✚ These 99 patients underwent Double Sequential External Cardioversion with each Defibrillator charged to 360J
- ✚ 66 were cardioverted on the first double attempt
- ✚ 14 were cardioverted on the second double attempt
- ✚ 81% of the 99 were successfully cardioverted



What Evidence Do We Have?

- ✚ 12 month period to remain in NSR is similar between the “standard” and the “high energy” group
- ✚ No incidence of CHF, no significant burns, no other known complications in this study associated with higher-energy shocks
 - ✚ Alaeddini J et al. PACE 2005;28:3-7



Does Higher Energy Cause Myocardial Damage?

- ✚ Atrial fibrillation patients who failed traditional cardioversion were enrolled in the study and treated with the “quadruple pad approach”
- ✚ Measured success of cardioversion, post-treatment CK-MB and troponin
 - ✚ Marroughe NF PACE 2001;24:1321-24



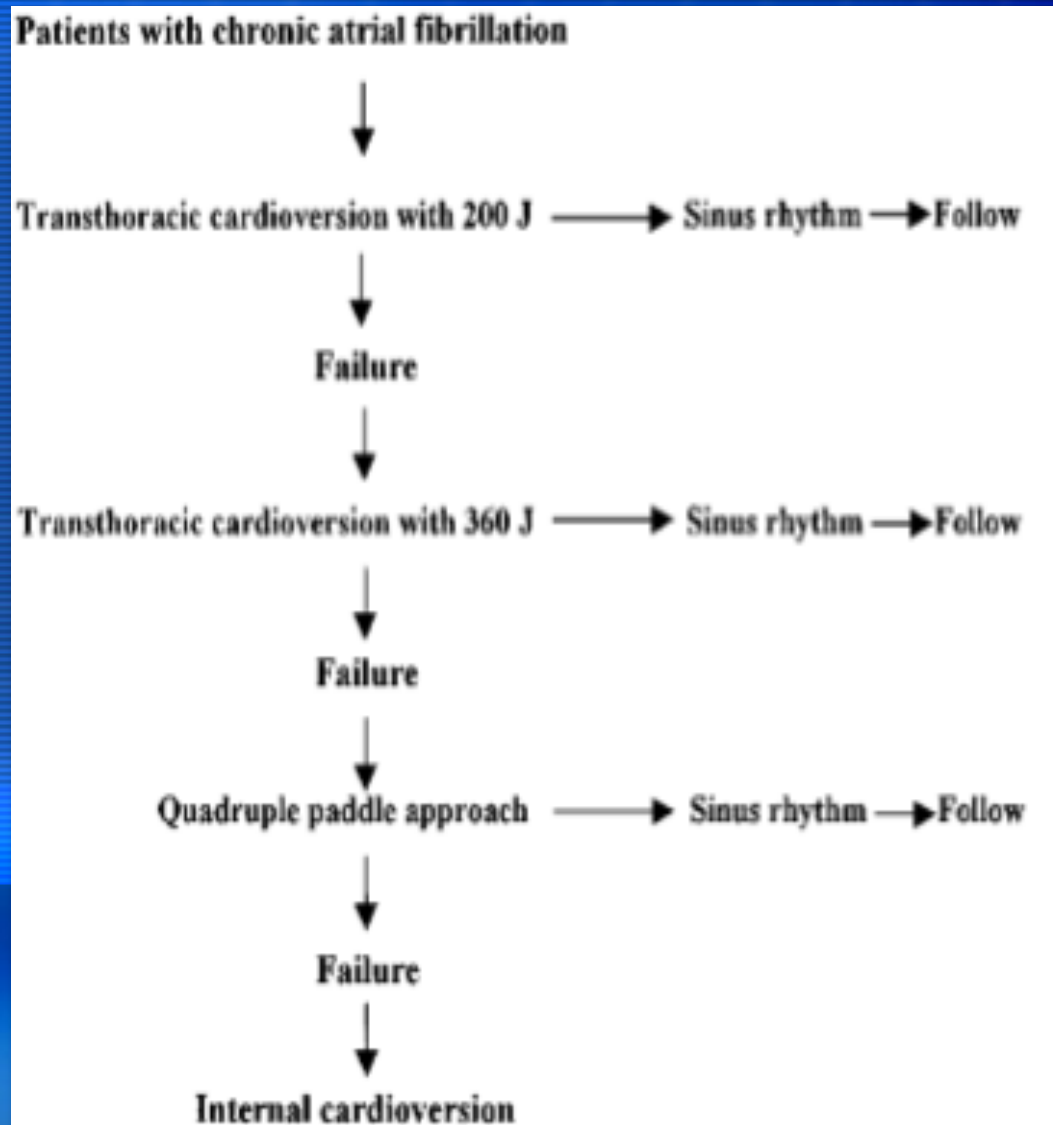


Figure 2. *Study protocol.*

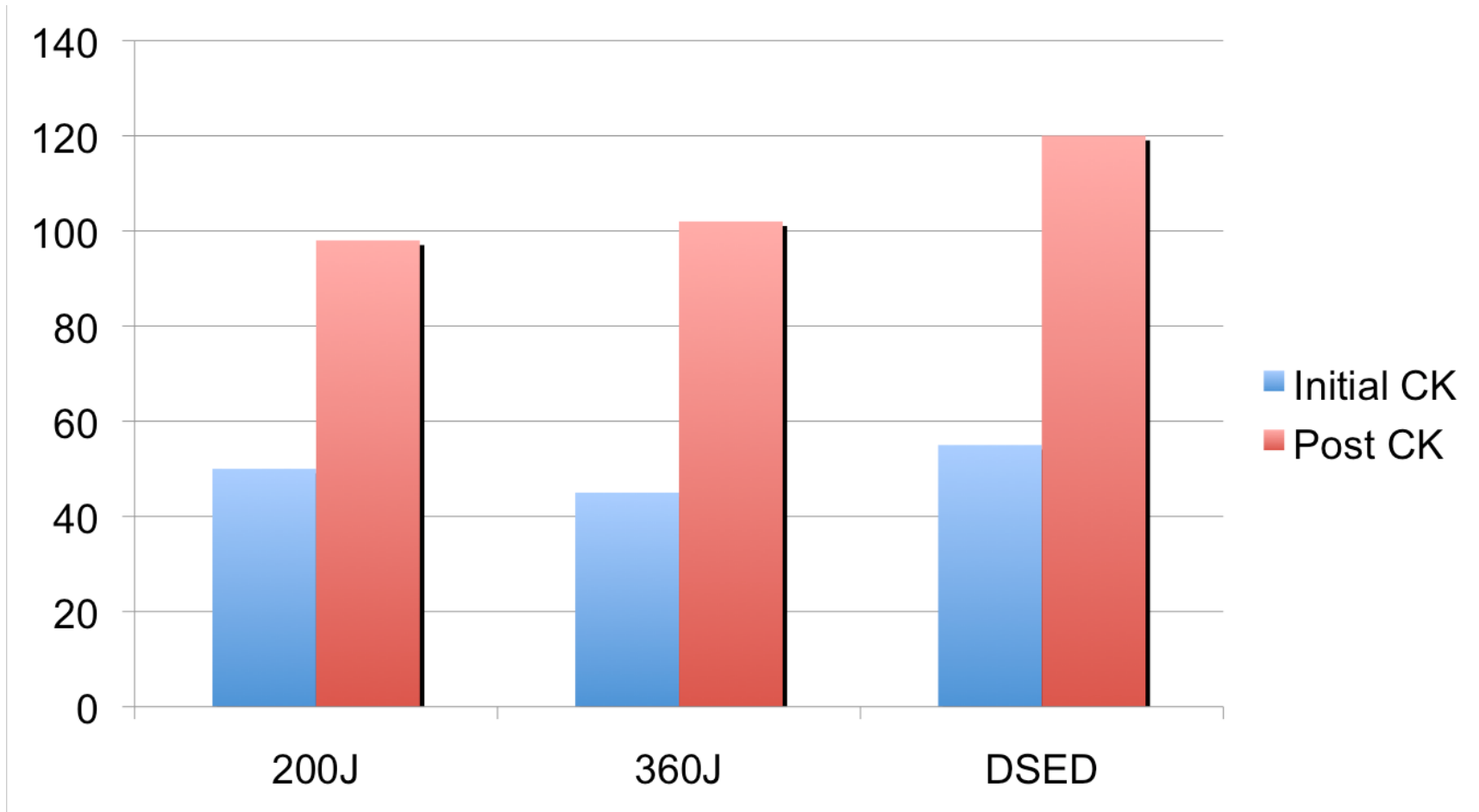


Results

- ✚ 46 patients failed chemical cardioversion
- ✚ 27 of these were successfully cardioverted after 200J + 360J
- ✚ 19 then underwent DSEC
- ✚ 14 were successfully cardioverted
- ✚ 4 of the remaining 5 failed transvenous cardioversion



Results



Here It Is – The Big Study

- ✚ 1994 study by Hoch et al
- ✚ 2,990 consecutive patients in 3 year EP lab experience with 5,450 total EP studies
- ✚ Treatment described was applied to 5 total patients



What Did We Say About 5 Things?

- ✚ Pre-DSED attempts ranged from 7 to 20 attempts with single device
- ✚ VF, VT, WPW, and AF were dysrhythmias encountered
- ✚ EF ranged from 10 to 60%
- ✚ Range between defibrillations was 0.5 to 4.5 seconds

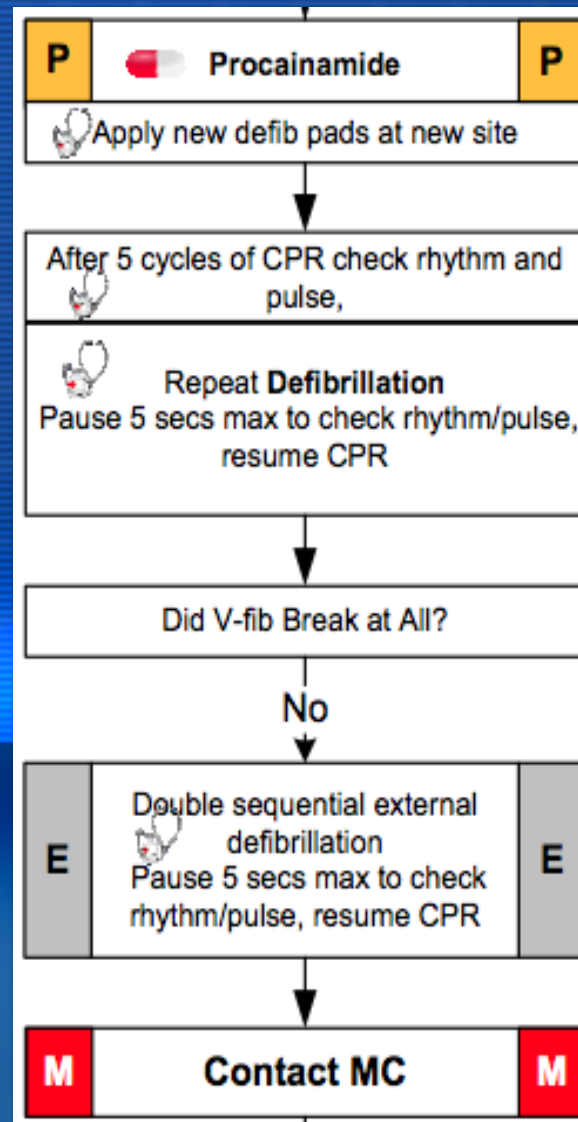


So What Happened?

- ✚ All five patients were successfully cardioverted on the first DSED
- ✚ “This finding, combined with its ease and limited morbidity, warrants further study of this approach”
- ✚ Hoch et al. J Am Coll Cardiol 1994;23:1141-5



Persistent Pathway



So What?

- ✚ Clearly, the greatest proportion of survivors are successfully defibrillated early (1 or 2 shocks) – 50% of our survivors never have an airway at all
- ✚ Should we, as Dr. Henry recently suggested, write off the rest?



What We're Gonna' Do

- ✚ Continue with proven compression, minimal ventilation, and hypothermia strategy
- ✚ Add aggressive treatment for those patients who experience “post-ACLS” ventricular fibrillation



**Everybody gets so much
Information all day long
That they lose their
Common sense**

-Gertrude Stein



