What To Do with Refractory Ventricular Fibrillation?

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“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
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 waveform.

+ 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-re-breather with 1 or more OPA or NPA as soon as other care activities will not be interrupted

**IO Procedure**

- **Epinephrine** 1 mg IV/IO repeat every 3-5 minutes
- **Vasopressin** 40 U IV/IO

After 5 cycles of CPR check rhythm and pulse

Repeat **Defibrillation**

After defibrillation resume CPR without pulse check

**Amiodarone**

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

- **Sodium Bicarbonate**

Establish a secondary circulatory access point

After 5 cycles of CPR check rhythm and pulse

Repeat **Defibrillation**

After defibrillation resume CPR without pulse check

**Magnesium Sulfate**

Consider **Epinephrine** drip

Repeat **Defibrillation**

After defibrillation resume CPR without pulse check

**Sodium Bicarbonate**

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
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

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

1. Procainamide
   q 2 mins to max
   - After 5 cycles of CPR check rhythm and pulse
   - Repeat Defibrillation
     - After defibrillation resume CPR without pulse check
   - Max Dose Procainamide reached?
     - Yes
     - Contact MC
     - No

2. Metoprolol
   q 2 mins to max
   - After 5 cycles of CPR check rhythm and pulse
   - Repeat Defibrillation
     - After defibrillation resume CPR without pulse check
   - Max Dose Metoprolol reached?
     - Yes
     - Contact MC
     - No
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
Patients with chronic atrial fibrillation

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Transthoracic cardioversion with 200 J → Sinus rhythm → Follow

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Failure

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Transthoracic cardioversion with 360 J → Sinus rhythm → Follow

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Failure

↓

Quadruple paddle approach → Sinus rhythm → Follow

↓

Failure

↓

Internal cardioversion

**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

The bar chart shows the comparison of results for different conditions:

- **200J**
- **360J**
- **DSED**

The chart indicates the performance data for both initial and post conditions, with higher values in the post-CK condition.
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”
Persistent Pathway

1. Procainamide
   - Apply new defib pads at new site

2. After 5 cycles of CPR check rhythm and pulse,
   - Repeat Defibrillation
     - Pause 5 secs max to check rhythm/pulse, resume CPR

3. Did V-fib Break at All?
   - No

4. Double sequential external defibrillation
   - Pause 5 secs max to check rhythm/pulse, resume CPR

5. Contact MC
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