Paisley Ties, Robert Plant, and Sodium Bicarbonate

J. Brent Myers, MD MPH
Director
Wake County Dept of EMS
Raleigh, NC

The Plan

- Review evidence regarding sodium bicarbonate
- Experience in an animal model
- What should we actually be doing?

Ivory Tower

In the Streets

Parachute use to prevent death and major trauma related to gravitational challenge: systematic review of randomised controlled trials

Gordon C S Smith, Jill P Pell

HULTON/GETTY

Parachutes reduce the risk of injury after gravitational challenge, but their effectiveness has not been proved with randomised controlled trials

Smith, Gordon GC British Medical Journal, 2003;327:1459-61

What is already known about this topic

Parachutes are widely used to prevent death and major injury after gravitational challenge

---

Parachute use is associated with adverse effects due to failure of the intervention and iatrogenic injury

---

Studies of free fall do not show 100% mortality

What this study adds

No randomised controlled trials of parachute use have been undertaken

---

The basis for parachute use is purely observational, and its apparent efficacy could potentially be explained by a "healthy cohort" effect

---

Individuals who insist that all interventions need to be validated by a randomised controlled trial need to come down to earth with a bump

What We Know

- Large clinical trial with post-hoc analysis
- Animal models with fast sodium channels
- Jim Menegazzi's cocktail

Improved resuscitation outcome in emergency medical systems with increased usage of sodium bicarbonate during cardiopulmonary resuscitation

G. Bar-Joseph[1,4], N. S. Abramson[1,2], S. F. Kelsey[3], T. Mashiach[5], M. T. Craig[1] and P. Safar[1] for the Brain Resuscitation Clinical Trial III (BRCT III) Study Group

[1]*Safar Center for Resuscitation Research, and Departments of* [2]*Emergency Medicine and* [3]*Epidemiology, University of Pittsburgh, Pittsburgh, PA, and* [4]*Pediatric Intensive Care Unit and* [5]*Quality Assurance Department, Rambam Medical Center and the Bruce Rappaport Faculty of Medicine, Technion – Israel Institute of Technology, Haifa, Israel*

Acta Anaesth Scanda 2004;49:6-15

What They Did

- This was the “high dose” epi trial
- Looked at 3 types of sodium bicarbonate users:
  - High users (5): Use bicarb in over 50% of cases and mean time to bicarb < 10 mins
  - Intermediate users (3): One of two above
  - Low users (8): Less than 50% and mean time to bicarb >10 mins

	ROSC ROSC+/total, n (%)		
	Low SB users	High SB users	*P**
VF or VT	151/578 (26.1)	91/281 (32.4)	0.056
AS or PEA	115/448 (25.7)	141/413 (34.1)	0.007

Good neurological outcome CPC1 or 2/total, n (%)		
Low SB users	High SB users	*P**
16/577 (2.8)	23/279 (8.2)	0.0005
6/448 (1.3)	14/443 (3.4)	0.005

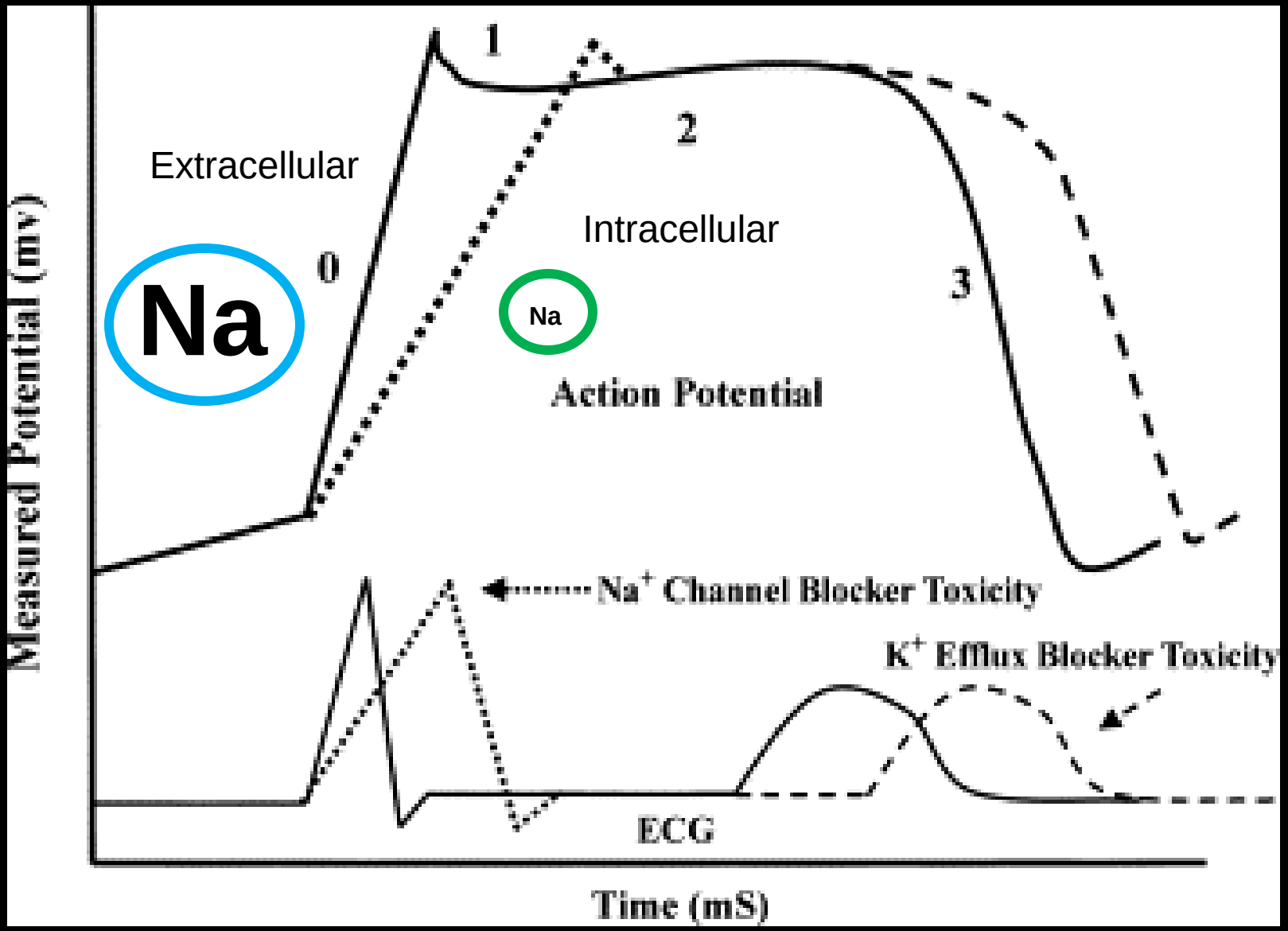
Variable	ROSC rate		
	OR	95% CI	*P*
Time collapse to ACLS[1]	1.32	1.07–1.63	0.01
Time from ACLS to Epi[2]	1.17	0.94–1.46	NS
Presenting rhythm[3]	1.02	0.82–1.27	NS
SB usage profile[4]	1.36	1.08–1.70	0.007
Epi treatment group[5]	0.80	0.64–0.98	NS
Sex[6]	1.40	1.11–1.77	0.004
Age[7]	1.21	0.97–1.51	NS

Odds of Neurologically Intact Survival

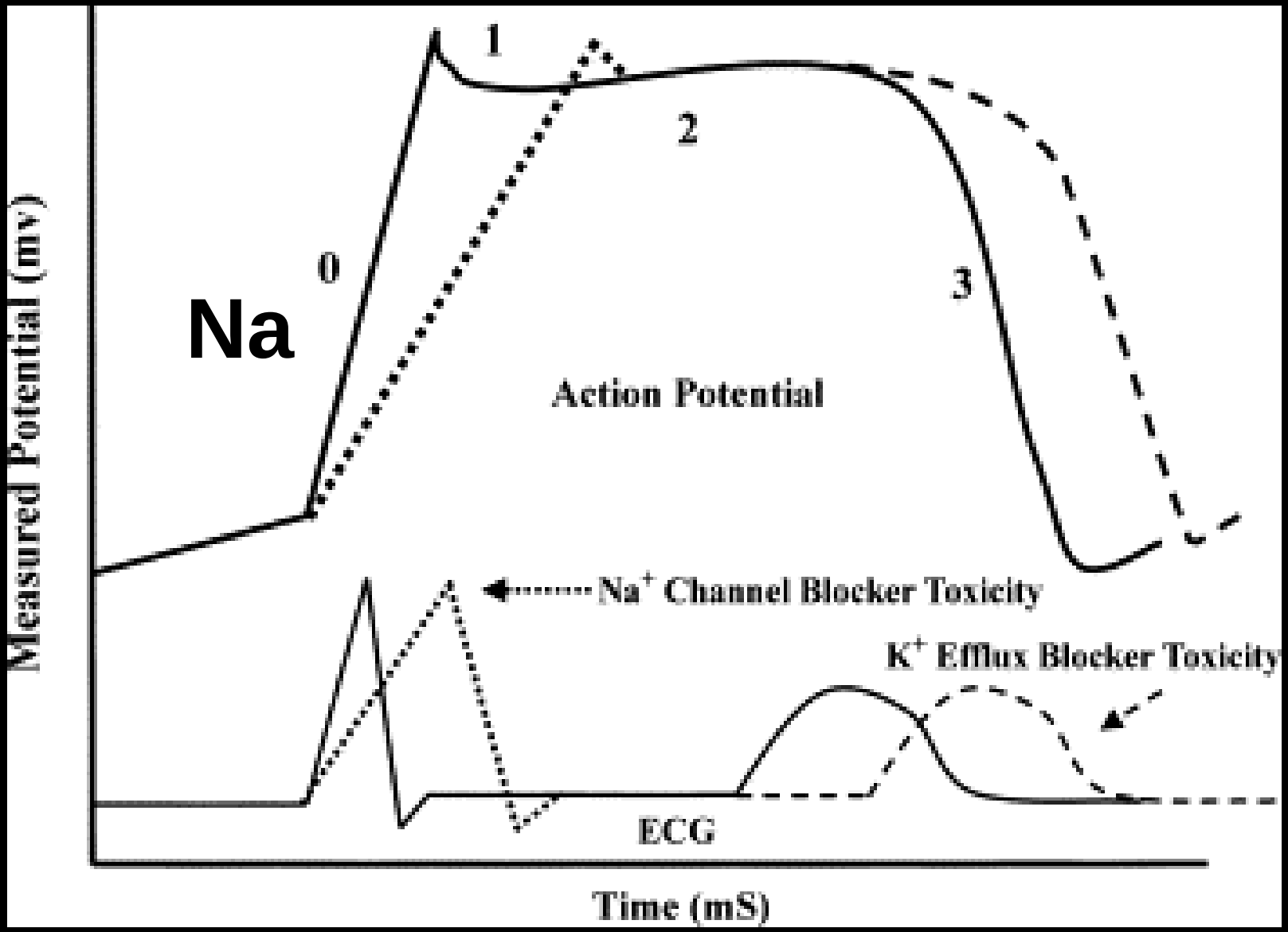
Time collapse to ACLS[1]	4.08	2.17–7.67	<0.001
Time from ACLS to Epi[2]	3.18	1.69–5.98	<0.001
Presenting rhythm[3]	2.75	1.52–4.98	0.001
SB usage profile[4]	2.18	1.23–3.86	<0.008
Epi treatment group[5]	1.11	0.65–1.89	NS
Sex[6]	1.43	0.77–2.65	NS
Age[7]	2.12	1.13–3.97	0.02

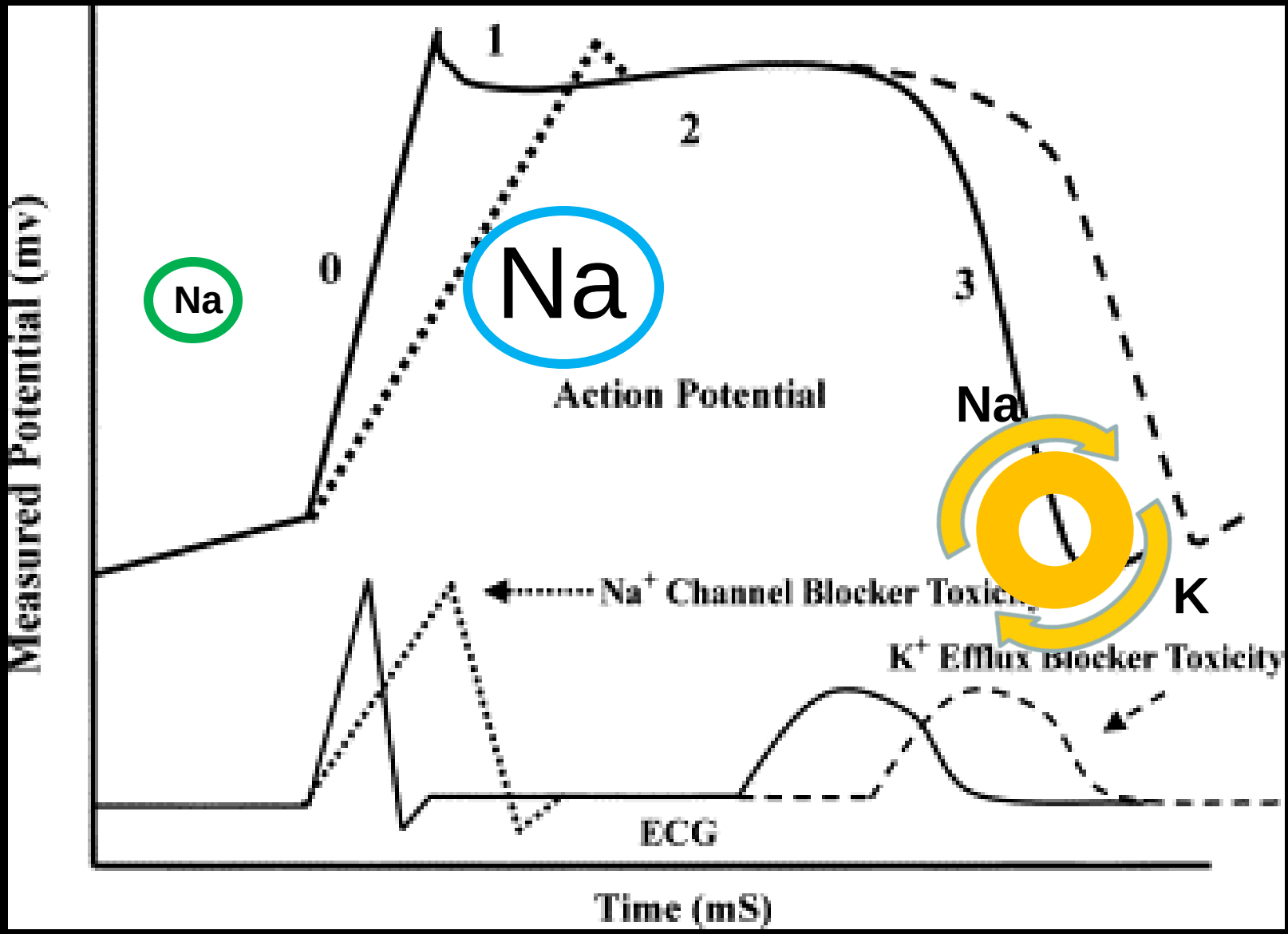
How Does It Work?

- Acid/Base believers
- Sodium load believers
- Some combination



http://emcrit.org/images/part1/actionpotekg.gif


Measured Potential (mv)
Na
0
1
2
3
Action Potential
Na+ Channel Blocker Toxicity
K+ Efflux Blocker Toxicity
ECG
Time (mS)


Measured Potential (mv)
Time (mS)
Action Potential
ECG
0
1
2
3
Na
Na
Na
K
Na+ Channel Blocker Toxicity
K+ Efflux Blocker Toxicity

TCA overdose

- QRS widens, presumably due to relative sodium channel blockade
- Cocaine has a similar mechanism
- Same effect (via different mechanism) for hypoxia-induced loss of extra vs. intra cellular sodium gradient

Animal Study

- All animals we made toxic with TCA

- 4 treatment groups
  - Control – Just D5W
  - Hypertonic saline
  - Sodium bicarbonate
  - Hyperventilation to achieve pH of 7.5 to 7.6

Table 3.

Survival at 60 minutes.

Group	Subjects Surviving	
Control	1/6	17%
HTS	5/6	83%
$NaHCO_3$	2/6	33%
Hyperventilation	1/6	17%

McCabe J et al. Annals of Emerg Med 1998;32:329-33

Does The Same Hold True for Class I antidysrhythmic OD ?

TABLE 1 -- Spontaneous VT Protocol: Flecainide Doses, Flecainide Plasma Concentrations, and Response to Treatment

	Control	$NaHCO_3$
Total flecainide dose at onset of VT (mg/kg)	58 ± 14	57 ± 24
Flecainide concentration 1 minute after third treatment (ng/mL)	7448 ± 2357	5411 ± 2542
Termination of VT by treatment (n)	1/7 (14%)	7/7 (100%) †
Time to recurrence of VT after treatment (min)	1.8 *	19.2 ± 24.4

† *P*< .01 *v* control.
* SD omitted because only one animal was a responder.

Salerno DM. Am J of Emerg Med 1995;13:285-93

Summary So Far

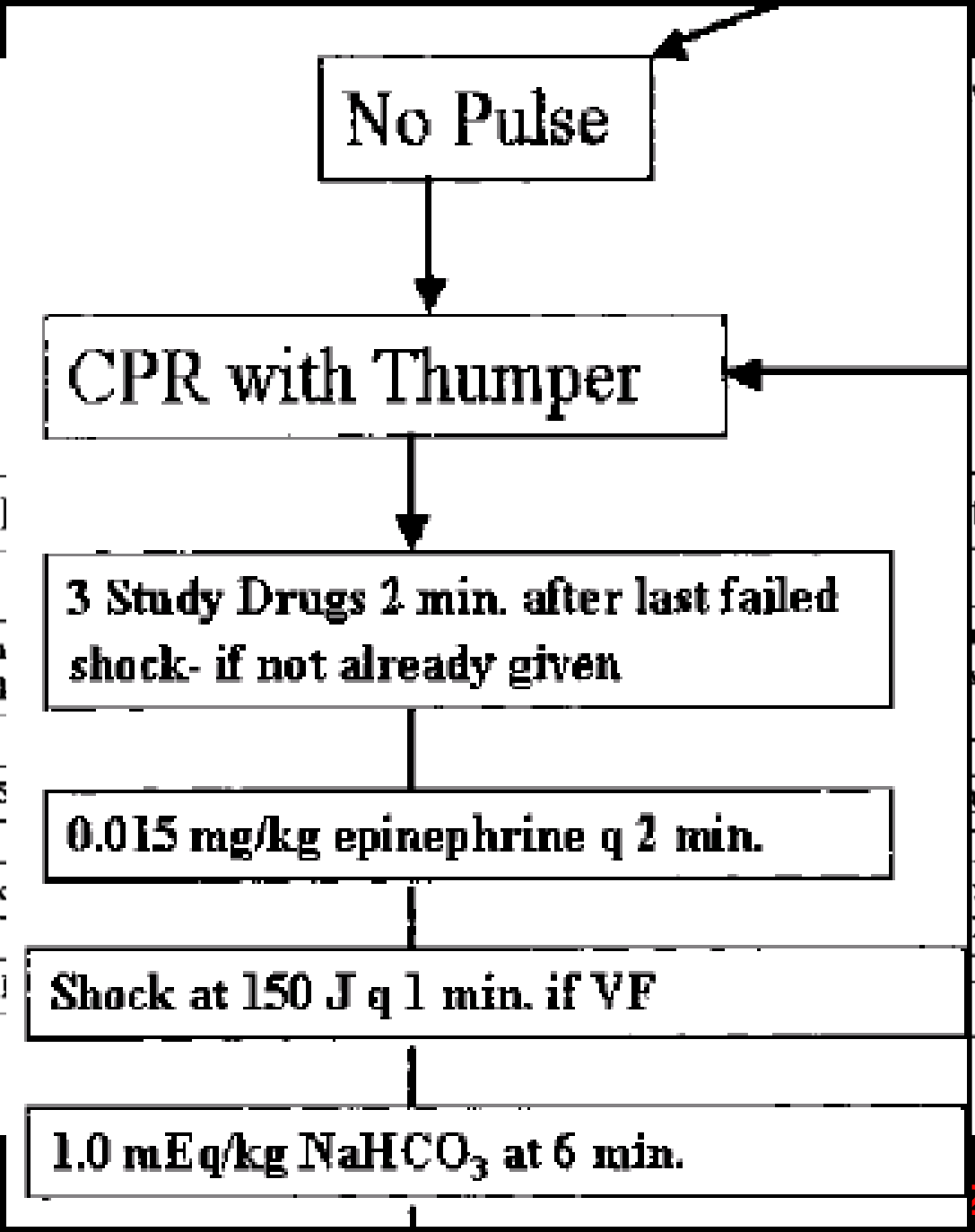
- No randomized controlled trial
- Best evidence in humans from one paper – seems to support bicarbonate use
- Animal studies also support use in limited situations

What Should We Do?

- Studies that placed bicarbonate in a lower priority were not of the highest quality
- A modest proposal follows

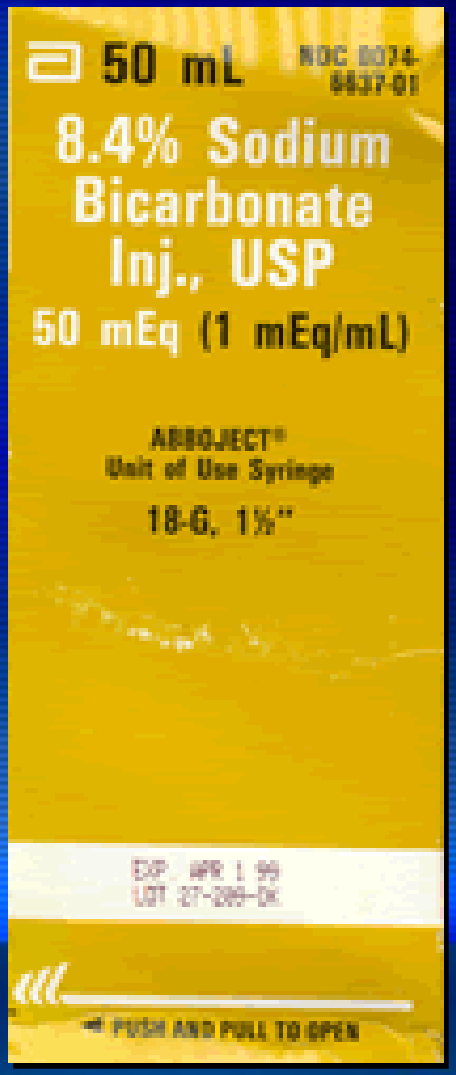
Menegazzi's Protocol

- The protocol is not the point of the study
- The study needs animals to achieve ROSC
- "Three drugs" are vasopressin, epinephrine, and propanolol


No Pulse
CPR with Thumper
3 Study Drugs 2 min. after last failed shock- if not already given
0.015 mg/kg epinephrine q 2 min.
Shock at 150 J q 1 min. if VF
1.0 mEq/kg $NaHCO_3$ at 6 min.

When the Call Comes

- Give good CPR
- Give airways their due
- Give pressors
- If refractory VF/VT or PEA/Asystole, consider bicarb
- If cocaine, TCA, or other sodium channel blockade a concern, give bicarb early




WAKE COUNTY
EMS
PARAMEDIC