

# ACLS - The Pharmacology

A non-sanctioned, non-sponsored,  
non-official discussion of  
medications used in ACLS in the  
pre-hospital environment

# Background and Purpose

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- The standardized approach of ACLS video supplemented classes reduced the ability to tailor information to the audience
- Students dealing with ACLS angst aren't the most receptive audience to anything else
- Memorization will get us through 16 hrs, but it has a tendency of failing at the fairly inopportune times

# Objectives

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- Refresh knowledge of ACLS medications
- Discuss reasons for changes in the last update
- Gain awareness of what else is 'out there'  
(Agency Protocols/Practices, studies, etc.)

# Common Sense Flow Chart



# Chain of Survival

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- Immediate recognition of cardiac arrest and activation of the emergency response system
- Early CPR that emphasizes chest compressions
- Rapid defibrillation if indicated
- Effective advanced life support
- Integrated post-cardiac arrest care

Berg RA et al. Part 5. *Circulation*. 2010;122(suppl 3):S685.

Effective implementation of the links of the chain can result in survival rates of witnessed out-of-hospital VF arrest approaching 50%

Rea TD et al. Increasing use of cardiopulmonary resuscitation during out-of-hospital ventricular fibrillation arrest: survival implications of guideline changes. *Circulation*. 2006; 114:2760-2765  
(As cited in *Circulation*. 2010; 122(suppl 3): S685.)

# Cardiac Arrest Pharmacology

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“The primary goal of pharmacologic therapy during cardiac arrest is to facilitate restoration and maintenance of a perfusing spontaneous rhythm”

Neumar et al. Part 8. *Circulation*. 2010: S743

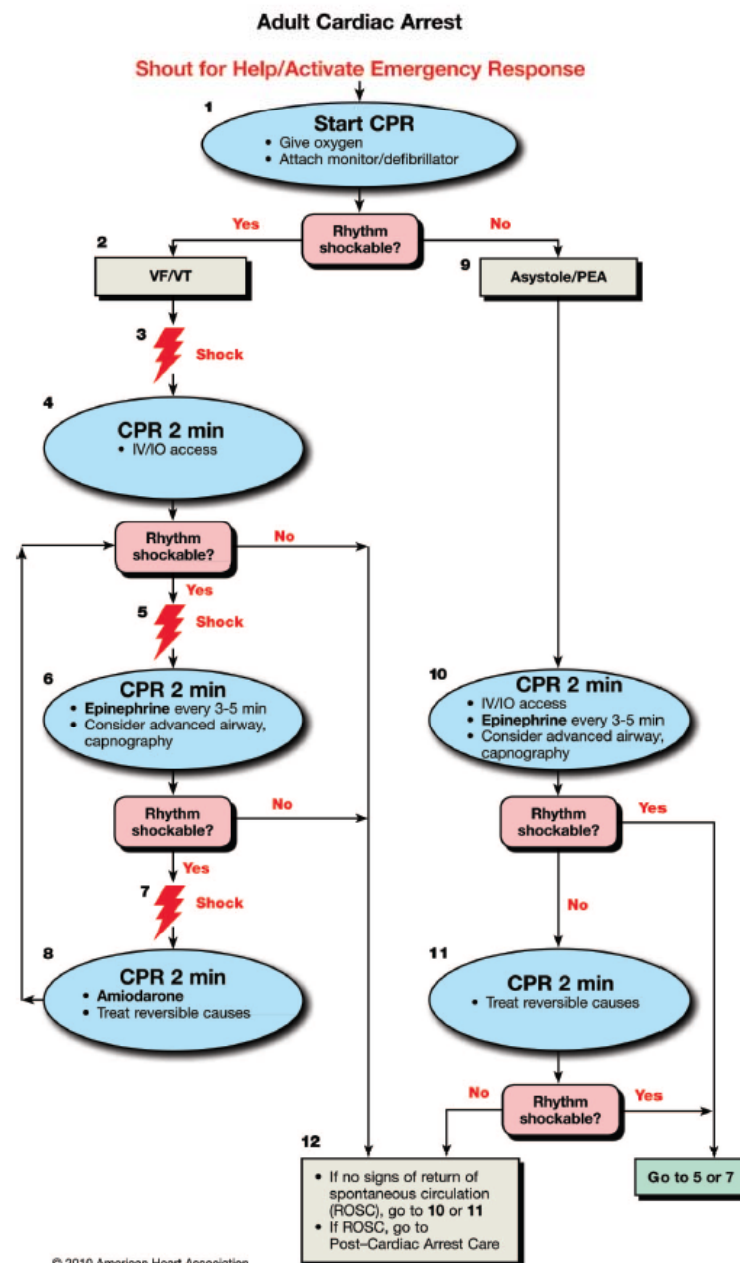


Figure 1. ACLS Cardiac Arrest Algorithm.

#### CPR Quality

- Push hard (≥2 inches [5 cm]) and fast (≥100/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Avoid excessive ventilation
- Rotate compressor every 2 minutes
- If no advanced airway, 30:2 compression-ventilation ratio
- Quantitative waveform capnography
  - If PETCO<sub>2</sub> <10 mm Hg, attempt to improve CPR quality
- Intra-arterial pressure
  - If relaxation phase (diastolic) pressure <20 mm Hg, attempt to improve CPR quality

#### Return of Spontaneous Circulation (ROSC)

- Pulse and blood pressure
- Abrupt sustained increase in PETCO<sub>2</sub> (typically ≥40 mm Hg)
- Spontaneous arterial pressure waves with intra-arterial monitoring

#### Shock Energy

- **Biphasic:** Manufacturer recommendation (eg, initial dose of 120-200 J; if unknown, use maximum available. Second and subsequent doses should be equivalent, and higher doses may be considered.
- **Monophasic:** 360 J

#### Drug Therapy

- **Epinephrine IV/IO Dose:** 1 mg every 3-5 minutes
- **Vasopressin IV/IO Dose:** 40 units can replace first or second dose of epinephrine
- **Amiodarone IV/IO Dose:** First dose: 300 mg bolus. Second dose: 150 mg.

#### Advanced Airway

- Supraglottic advanced airway or endotracheal intubation
- Waveform capnography to confirm and monitor ET tube placement
- 8-10 breaths per minute with continuous chest compressions

#### Reversible Causes

- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary

# Asytrole/PEA

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- Epinephrine – 1 mg
  - Repeat every 3-5 minutes
- Vasopressin – 40 Units
  - May replace 1<sup>st</sup> or 2<sup>nd</sup> dose of epi
- What happened to Atropine?
  - Sodium Bicarb?

# IV, IO, or ETT route?

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- What is your plan of attack?
- Why the de-emphasis of endotracheal medications?
  - Drug Concentration
  - Predictability of delivery and effect

Neumar et al. Part 8. *Circulation*. 2010: S743

# Vasopressors

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# Vasopressors

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## Epinephrine

### ● What is it?

- Catecholamine
- Sympathomimetic
- Adrenergic Receptor Agonist
- Can you still name the receptors we are looking to activate in arrest? (bonus for the biologic effect they cause)

# Vasopressors

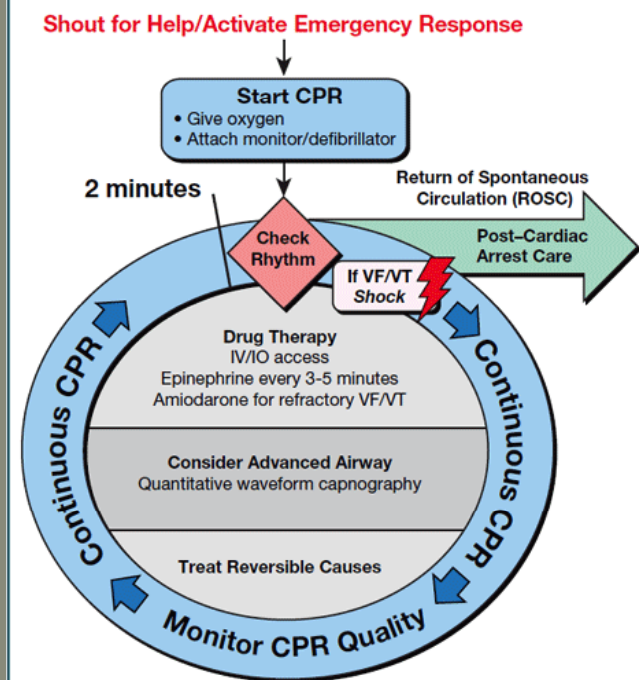
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## Epinephrine

- So when are you giving the 1 mg?
  - Is this important?

# Vasopressors

**Figure 4**  
Circular ACLS Algorithm



The ‘circular algorithm’ introduced to emphasize the importance of CPR

“There is insufficient evidence to recommend a specific timing or sequence of drug administration and advanced airway placement during cardiac arrest.”

Neumar et al. Part 8. *Circulation*. 2010:S737

# Vasopressors

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## Epinephrine

- So when are you giving the 1 mg?
  - Is this important?
- The half-life of catecholamines are measured in minutes (2ish)

# Vasopressors

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## Vasopressin

### ● What is it?

- A Peptide Hormone
- Responsible for regulating water retention by controlling reabsorption in the tubules of the kidneys
- Increases PVR
  - Causing B/P increase

# Vasopressors

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## Vasopressin

- How is it different from Epinephrine?
  - Specificity
    - We know how Epi affects cardiac muscle
    - Desirable effects of increased PVR without acting on non-specific adrenergic receptors
  - Half life
- So why just consideration

N Sharman A & Low J. *Vasopressin and its role in critical care.*

# VF/Pulseless VT

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- Vasopressor

- Anti-Arrhythmic

- Amiodarone 300 mg
  - Second dose of 150 mg

Or

- Lidocaine 1-1.5 mg/kg
  - Additional dosing 0.5 – 0.75 mg/kg every 5-10 min. to a max of 3 mg/kg

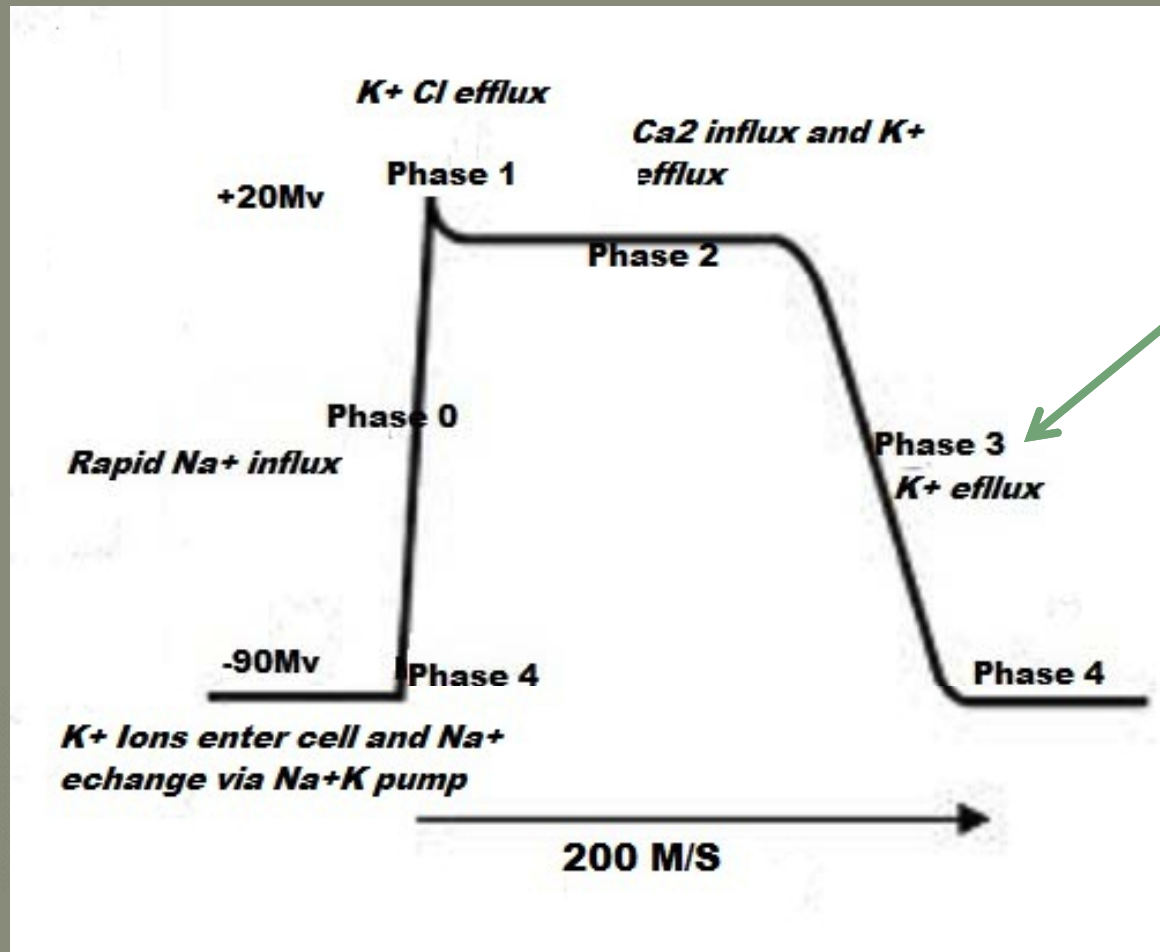
# Antiarrhythmics

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## Amiodarone

- Class III antiarrhythmic agent
  - Prolongs phase 3 (repolarization) of the cardiac action potential

# Revisiting Bad Memories From Medic School...



<http://www.emergencymedicalparamedic.com/cardiac-action-potential/>

# Antiarrhythmics

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## Amiodarone

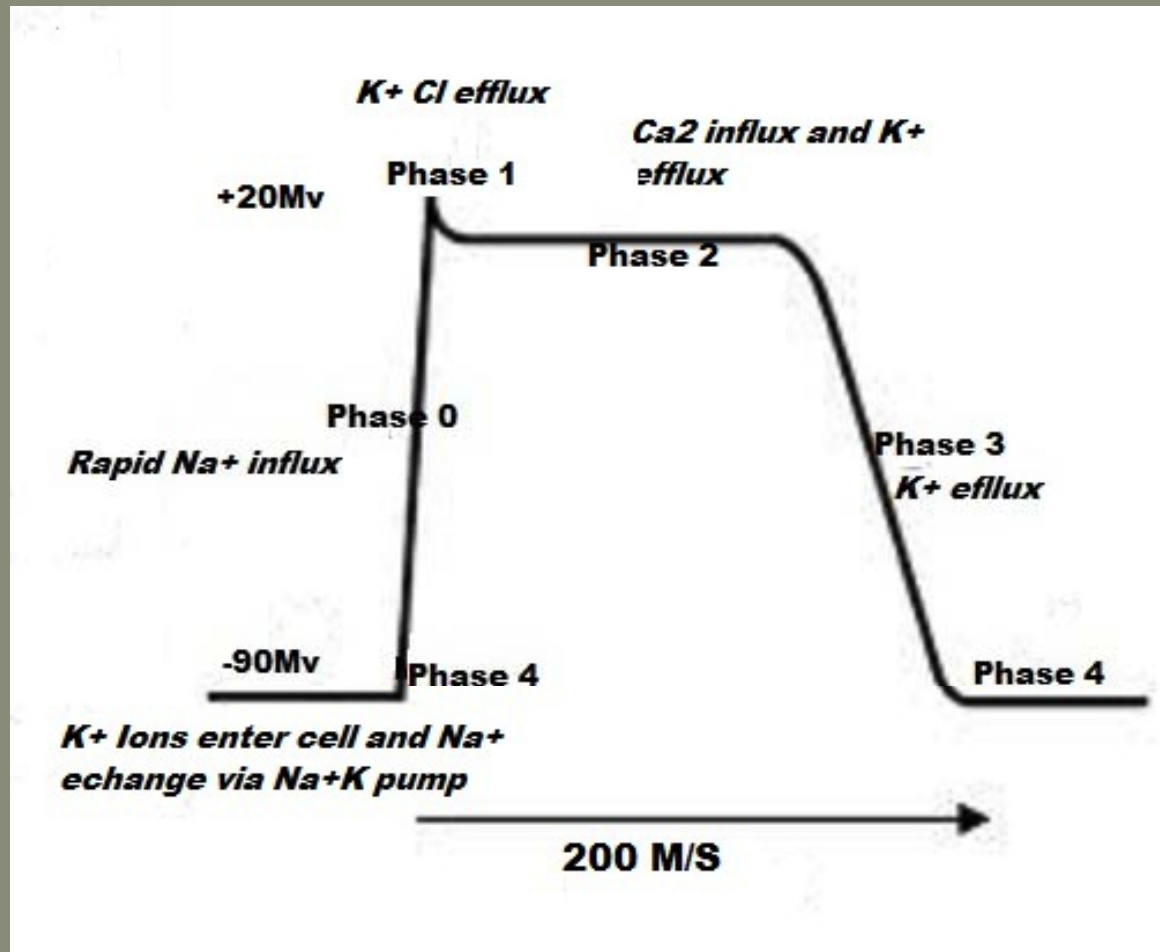
### ● Class III antiarrhythmic agent

- Prolongs phase 3 (repolarization) of the cardiac action potential
- In English – Potassium Channel Blocker

And...

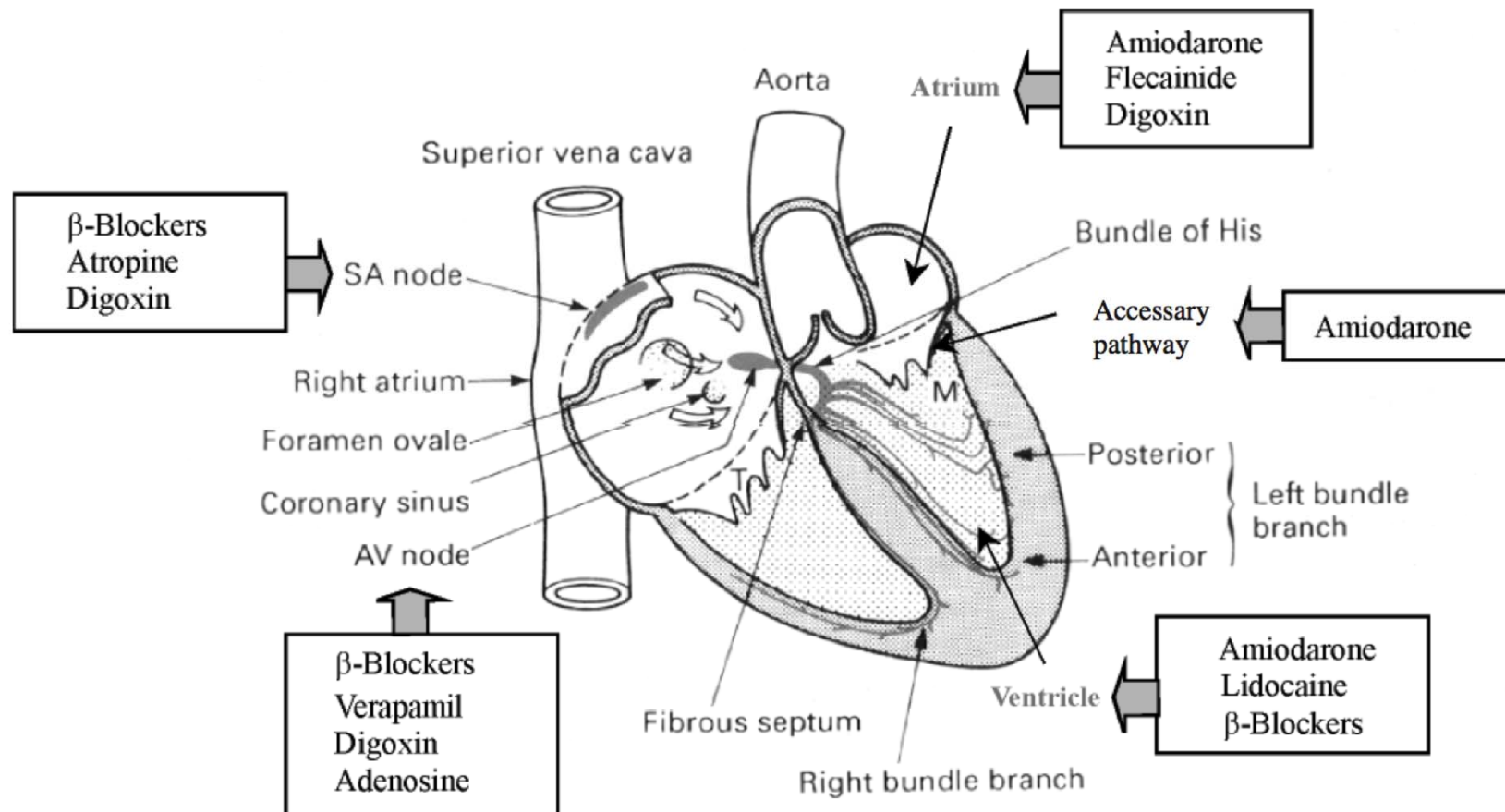
- It has effects similar to class Ia
- II
- IV

# Revisiting Bad Memories From Medic School...Round 2



<http://www.emergencymedicalparamedic.com/cardiac-action-potential/>

# For the visual learners



Sanghavi S & Rayner-Klein. Management of Peri-arrest Arrhythmia.

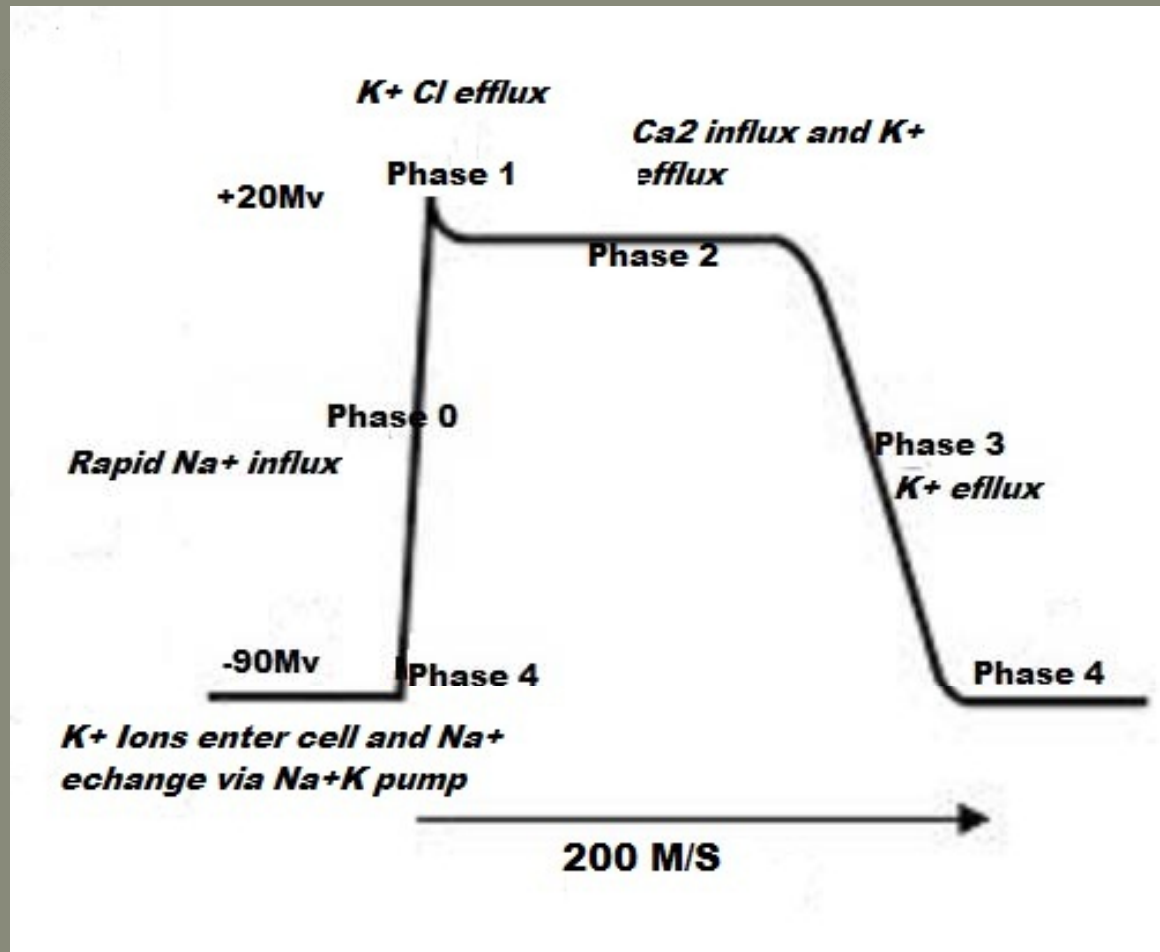
# Antiarrhythmics

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## Lidocaine

- How does it 'anti' the arrhythmia?
  - Class Ib

# Revisiting Bad Memories From Medic School...Round 3



<http://www.emergencymedicalparamedic.com/cardiac-action-potential/>

# Antiarrhythmics

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## Lidocaine

- How does it 'anti' the arrhythmia?
  - Class Ib

Just Kidding!

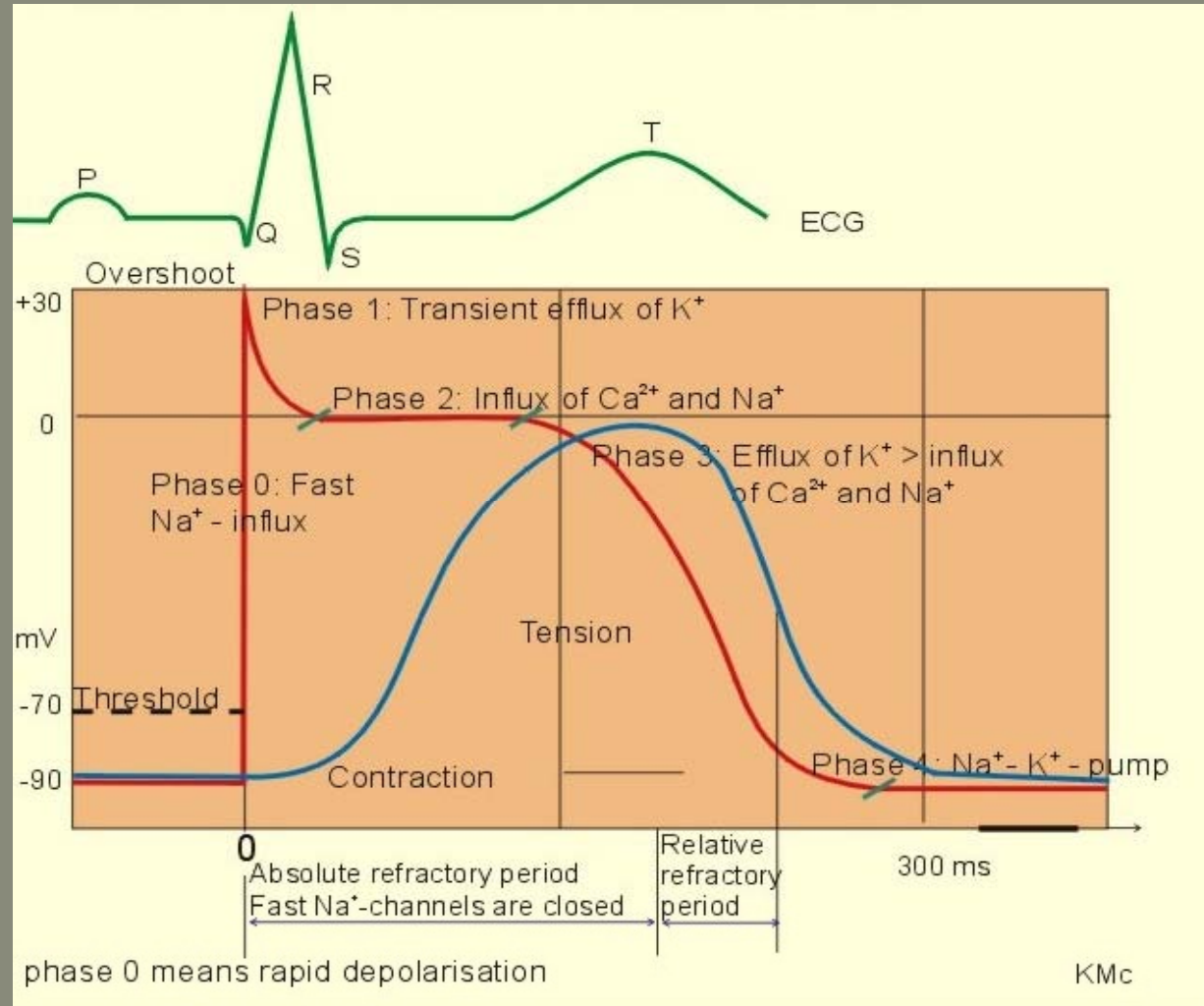
# Antiarrhythmics

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## Lidocaine

- How does it 'anti' the arrhythmia?
  - Class Ib
  - Na<sup>+</sup> Channel Blocking
  - So ventricular arrhythmias

# Don't Shoot!



# Antiarrhythmics

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## ● Amio vs. Lido

- Is anyone using Lidocaine?
- What the Amiodarone studies say
- What the Lidocaine studies say

## ● We have our first declared winner!

# What did we miss in CA?

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## Magnesium Sulfate

- Electrolyte
- Indications
  - TdP
- Mechanism of Action
- Study Results

ACS

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“Half of the patients who die of ACS do so before reaching the hospital”

O'Connor et al. Part 10. *Circulation*. 2010;122(suppl 3):S789.

# Pharm for ACS

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- Is Mona still greeting everyone at the door?
  - She got cut back to part-time
- Oxygen
- ASA
- Nitrates
- Morphine (analgesia)

ANOA just isn't catchy..

# ACS Pharm

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## Oxygen

### ● So why the change

- Studies!
- Oxygen still there for the respiratory distress, heart failure, shock

### ● ASA

- Why?
- What if they took their own?

# ACS Pharm

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- Nitrates
  - Concerns?
- Pain management
  - With?
- Beta-Blockers

# Pharmacology in the presence of a pulse

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Mistakes may be more readily evident...

# Interesting Points of 2010

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- Return of the term *symptomatic*
- Underlying cause identification gets a nod
- Changes to Bradycardia
- Changes to Tachycardia

# Bradycardia

## Identify and treat underlying cause

- Maintain patent airway; assist breathing as necessary
- Oxygen (if hypoxemic)
- Cardiac monitor to identify rhythm; monitor blood pressure and oximetry
- IV access
- 12-Lead ECG if available; don't delay therapy

## Persistent bradyarrhythmia causing:

- Hypotension?
- Acutely altered mental status?
- Signs of shock?
- Ischemic chest discomfort?
- Acute heart failure?

## Atropine

If atropine ineffective:

- Transcutaneous pacing  
OR
- **Dopamine** infusion  
OR
- **Epinephrine** infusion

# Bradycardia

## **Doses/Details**

### **Atropine IV Dose:**

First dose: 0.5 mg bolus

Repeat every 3-5 minutes

Maximum: 3 mg

### **Dopamine IV Infusion:**

2-10 mcg/kg per minute

### **Epinephrine IV Infusion:**

2-10 mcg per minute

# Bradycardia

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## Atropine

- Anticholinergic
- Nonselective muscarinic acetylcholinergic antagonist
  - So...
  - Guerilla warfare against the Parasympathetic NS
    - Infiltration
    - Remove the command structure
    - Interruption of communications

# Bradycardia

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## Atropine

- Any considerations prior to counter-insurgency?
- And what about the 'high blocks'?

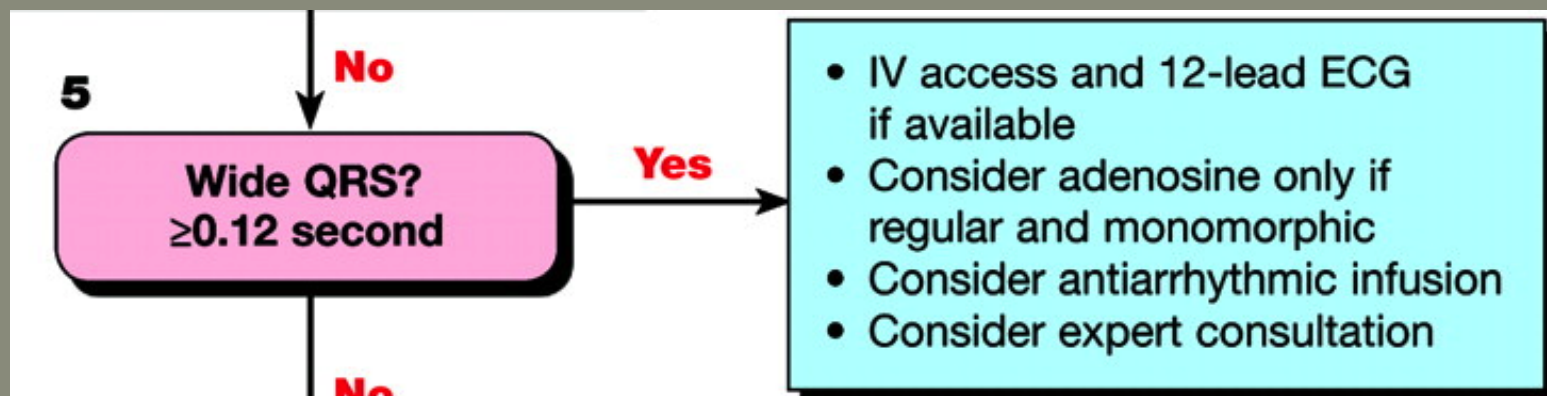
# Bradycardia

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- Our common pressors haven't changed
  - Epi
  - Dopamine
- So lets talk ino/chrono/dromo tropes
  - Inotrope
  - Dromotrope
  - Chronotrope

# Tachycardia

- Whats the biggest change in 2010 guidelines?



# Some interesting differences

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- Richmond Ambulance Authority varies the practice a bit
- From 1/1/09 – 10/31/12
  - Out of Hospital Cardiac Arrests: 765 (40% unwitnessed)
  - ROSC at Hospital: 206
    - That's 27% of patients included
    - Bystander CPR in 24%
  - National ROSC without bystander CPR: 15%

# Stats

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- Autopulse Usage

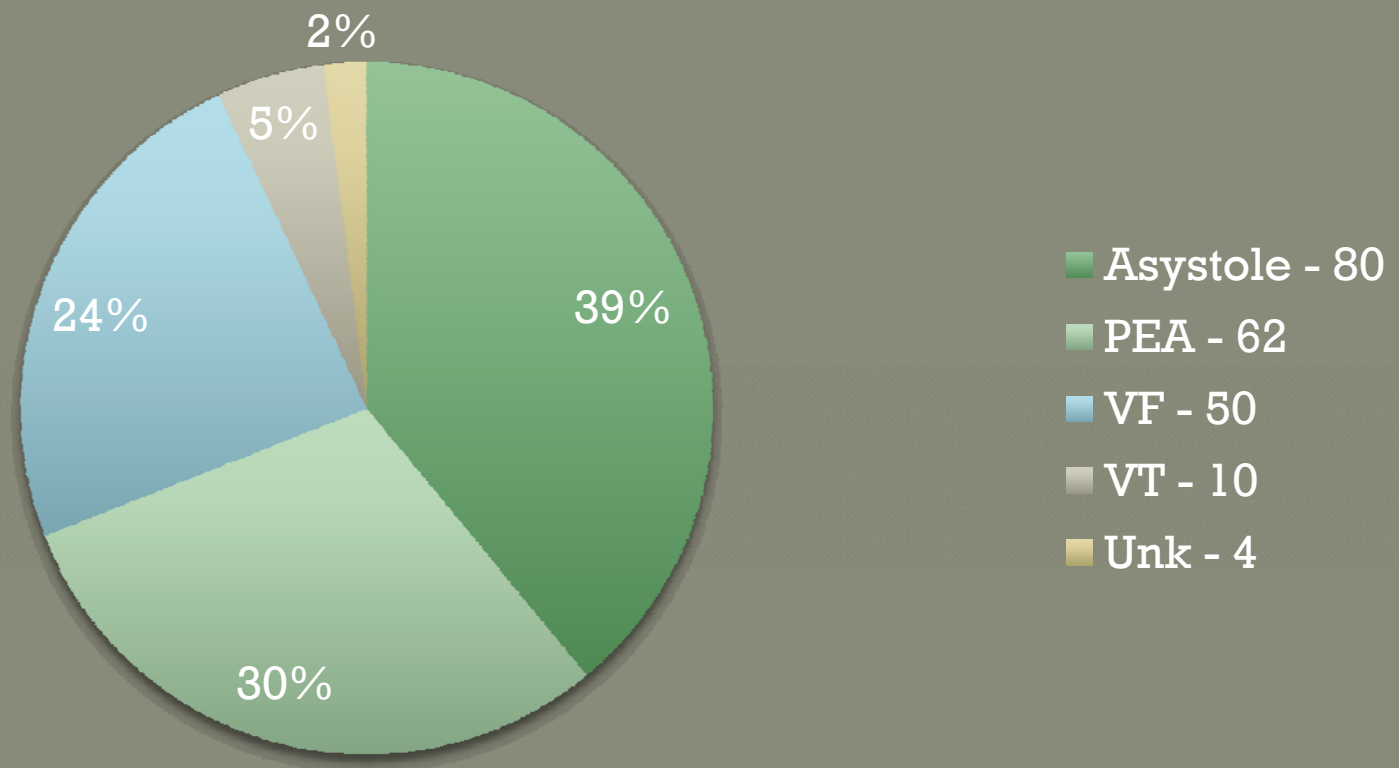
- 161 of the 206 with ROSC: 83% (failures excluded)

- Avg # of Epi doses per arrest – 1.6

- Avg # of Vaso doses per arrest – 1.5

# Stats

## Breakdown of ROSC by initial Rhythm



# What's different

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- Autopulse
- Vasopressin
- Short Transport
- Hypothermia starting in the field
  - In 2009, 52% of patients with ROSC and hypothermia started in the field survived to hospital discharge

Neumar, Robert W., et al. "Implementation Strategies for Improving Survival After Out-of-Hospital Cardiac Arrest in the United States Consensus Recommendations From the 2009 American Heart Association Cardiac Arrest Survival Summit." *Circulation* 123.24 (2011): 2898-2910.

**Questions, Concerns,  
Discussion?**

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Neumar, Robert W., et al. "Implementation Strategies for Improving Survival After Out-of-Hospital Cardiac Arrest in the United States Consensus Recommendations From the 2009 American Heart Association Cardiac Arrest Survival Summit." *Circulation* 123.24 (2011): 2898-2910.