

**Project:** Ghana Emergency Medicine Collaborative

**Document Title:** Advanced Cardiac Life Support

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# ACLS

- Systematic approach to assessment and management of cardiopulmonary emergencies
- Continuation of Basic Life Support
- Resuscitation efforts aimed at restoring spontaneous circulation and retaining intact neurologic function

# ABCD

# The AAA's

- Assess the patient
  - Establish unresponsiveness
  - Check pulse, respirations
- Activate EMS
  - Call for help
- AED
  - Get an AED (automated external defibrillator)

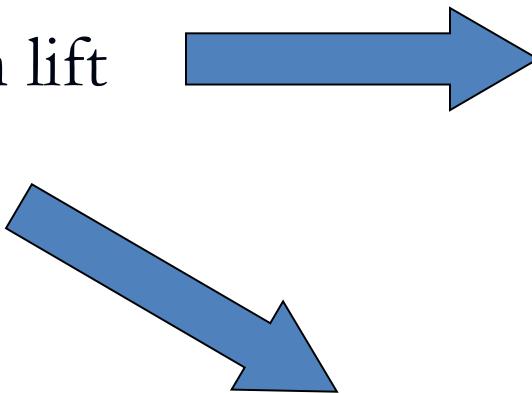
# Primary Survey (BLS)

- Airway
- Breathing
- Circulation
- Defibrillation

Always assess and manage before moving on to the next step!

# Airway

- Open the airway
  - Head tilt-chin lift
  - Jaw thrust



# Breathing

- Look, Listen and Feel



- Give 2 rescue breaths



- Watch for appropriate chest rise and fall

# Circulation

- Check for a pulse
- Start CPR
  - 30 compressions/2 respirations
- Compressions more important than respirations!



U.S. Navy photo by Mass Communication Specialist Seaman Gabriel S. Weber, [Wikimedia Commons](#)

# Defibrillation

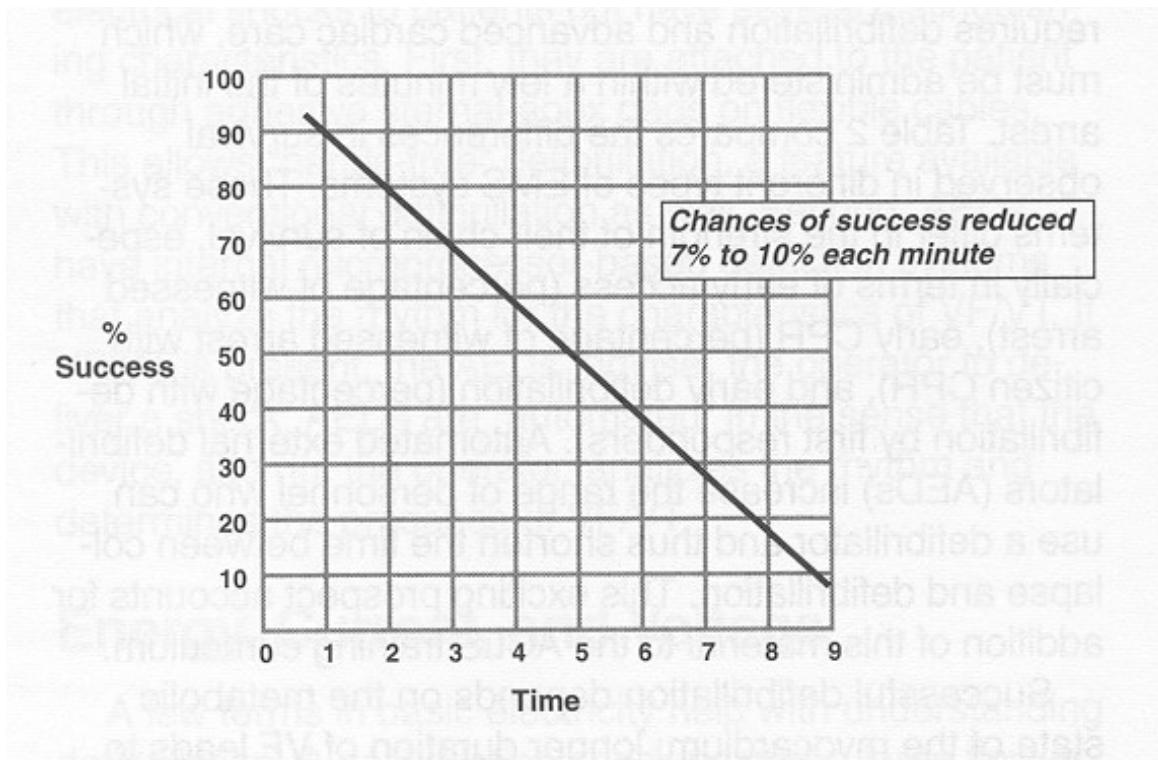
- Know your AED
- Universal steps:
  1. Power ON
  2. Attach electrode pads
  3. Analyze the rhythm
  4. Shock (if advised)



# Defibrillation

- Most frequent initial rhythm in witnessed sudden cardiac arrest is ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT) which rapidly deteriorates into VF
- The only effective treatment for VF is electrical defibrillation
- Probability of successful defibrillation diminishes rapidly over time
- VF rapidly converts to asystole if not treated

# Early Defibrillation = Increased Survival



# Outcomes of Rapid Defibrillation by Security Officers after Cardiac Arrest in Casinos

- NEJM Vol 343 (17) October 26, 2000
- Used AEDs on 105 patients with Ventricular Fibrillation
- 53% survived to discharge (back to casino)
- Previously, less than 5% survive

# Public-Access Defibrillation and Survival after Out-of-Hospital Cardiac Arrest

- NEJM 2004
- Community based trial of AED deployment and layperson training.
- 30 in AED group versus 15 survivors in CPR only group to hospital discharge
- Average age of survivor - 69.8 years
- Study cost - \$9.5 million

# Secondary Survey (ACLS)

- Airway
- Breathing
- Circulation
- Differential Diagnosis
- Assess and manage at each step before moving on!

# Airway

- Maintain airway patency
  - Head tilt-chin lift/jaw thrust
  - Oro- or nasopharyngeal airway
- Advanced airway management
  - ETT
  - Combitube
  - LMA



# Breathing

- Assess adequacy of oxygenation and ventilation
- Provide supplemental oxygen
- Confirm proper airway placement
- Secure tube

# Circulation

- Assess/monitor cardiac rhythm
- Establish IV access
- Give medications as appropriate for rhythm and BP
- Fluid resuscitation
- Minimize interruption of compressions to maximize survival.

# Differential Diagnosis

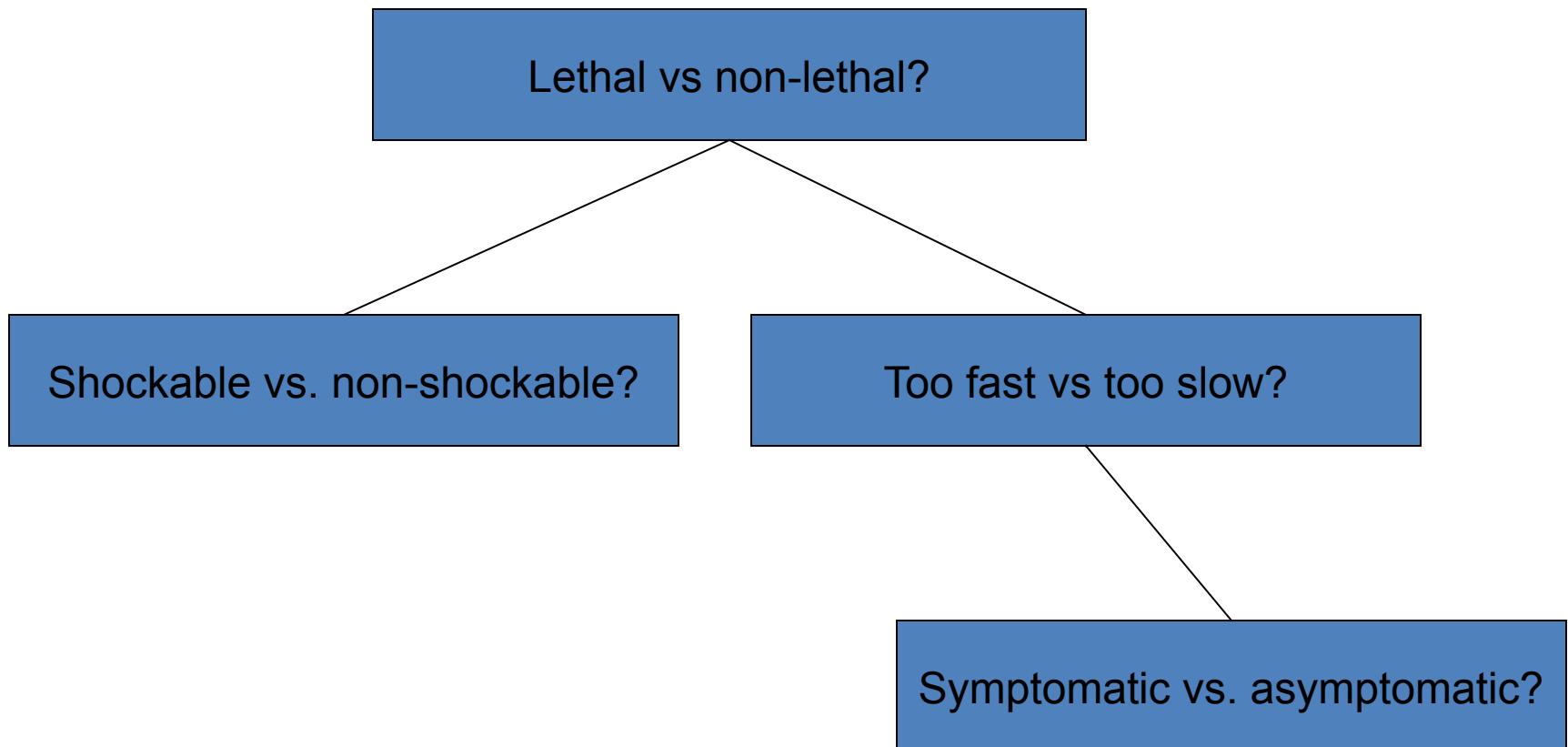
- Look for and treat any reversible cause of arrest

# Basic Rhythm Analysis

# Basic Rhythm Analysis

- Rate – too fast or too slow?
- Rhythm – regular or irregular?
- Is there a normal looking QRS? Is it wide or narrow?
- Are P waves present?
- What is the relationship of the P waves to the QRS complex?

# Rhythm Analysis



# Lethal Rhythms

- Shockable (Defibrillation)
  - Ventricular fibrillation
  - Pulseless ventricular tachycardia
- Non-shockable
  - Asystole
  - Pulseless electrical activity

# Non-Lethal Rhythms

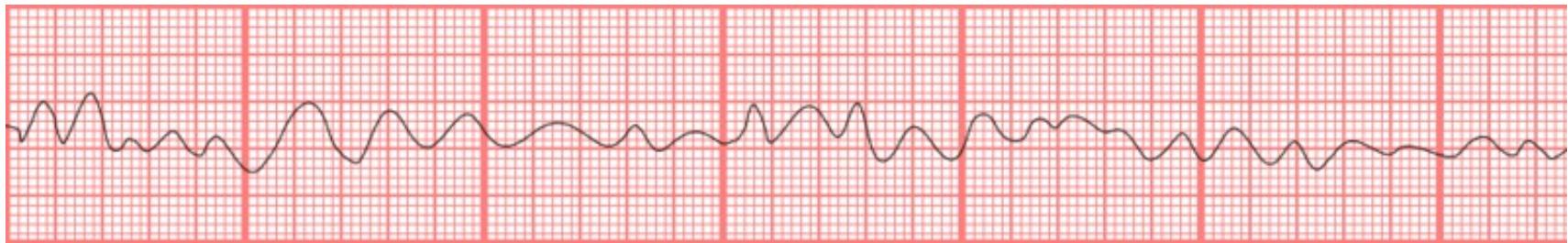
- Too fast (tachycardias)
  - Sinus
  - Supraventricular (including a-fib/flutter)
  - Ventricular
- Too slow (bradycardias)
  - Sinus
  - Heart block ( $1^\circ$ ,  $2^\circ$ ,  $3^\circ$  AV block)

# What is a Symptomatic Dysrhythmia?

- Any abnormal rhythm that produces signs or symptoms of hypoperfusion
  - Chest Pain/ischemic EKG changes
  - Shortness of Breath
  - Decreased level of consciousness
  - Syncope/pre-syncope
  - Hypotension
  - Shock - decreased Uop, cool extremities, etc.
  - Pulmonary Congestion/CHF

Name that rhythm...

63 yo man with a witnessed collapse while mowing the lawn



What is the rhythm?

What is the management?

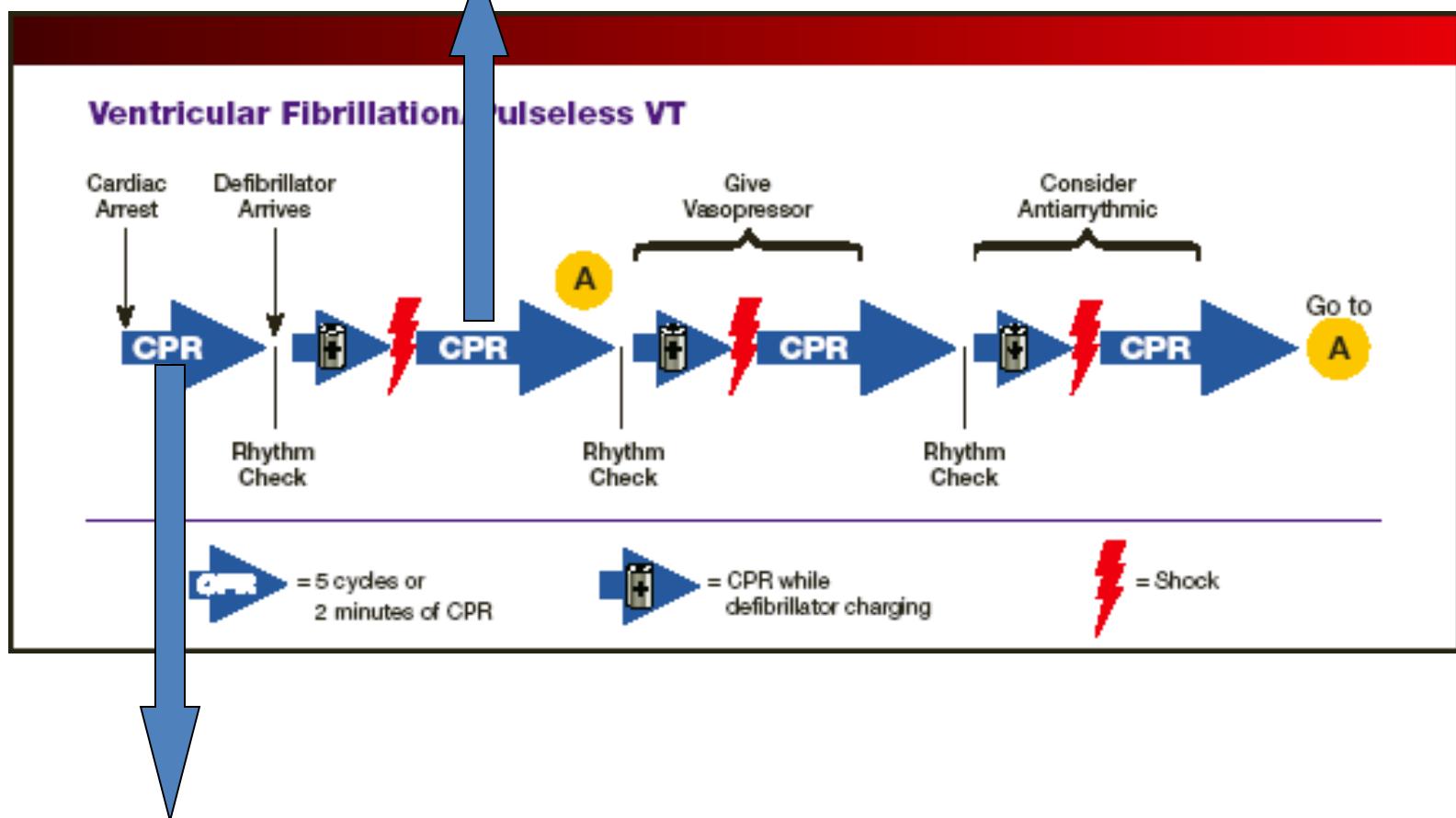
# Ventricular Fibrillation



- Rapid and irregular
- No normal P waves or QRS complexes

# VF / Pulseless VT

## Secondary Survey - ABC

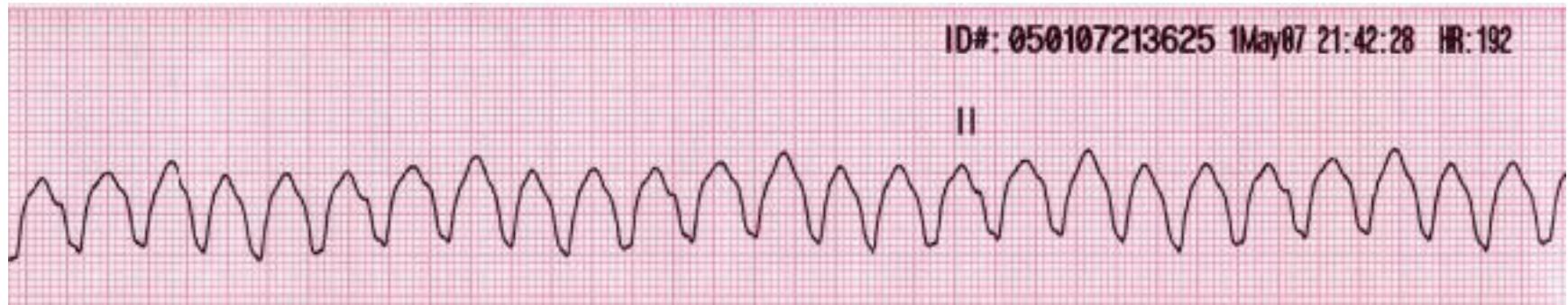


## Primary Survey - ABC

# ACLS Algorithm

- Primary Survey
- Shock – 360 J
- Secondary Survey
- Vasopressor - Epi or Vasopressin IV
- Shock 360J
- Antiarrhythmic – Amiodarone, Lidocaine or Magnesium Sulfate IV
- Shock 360J

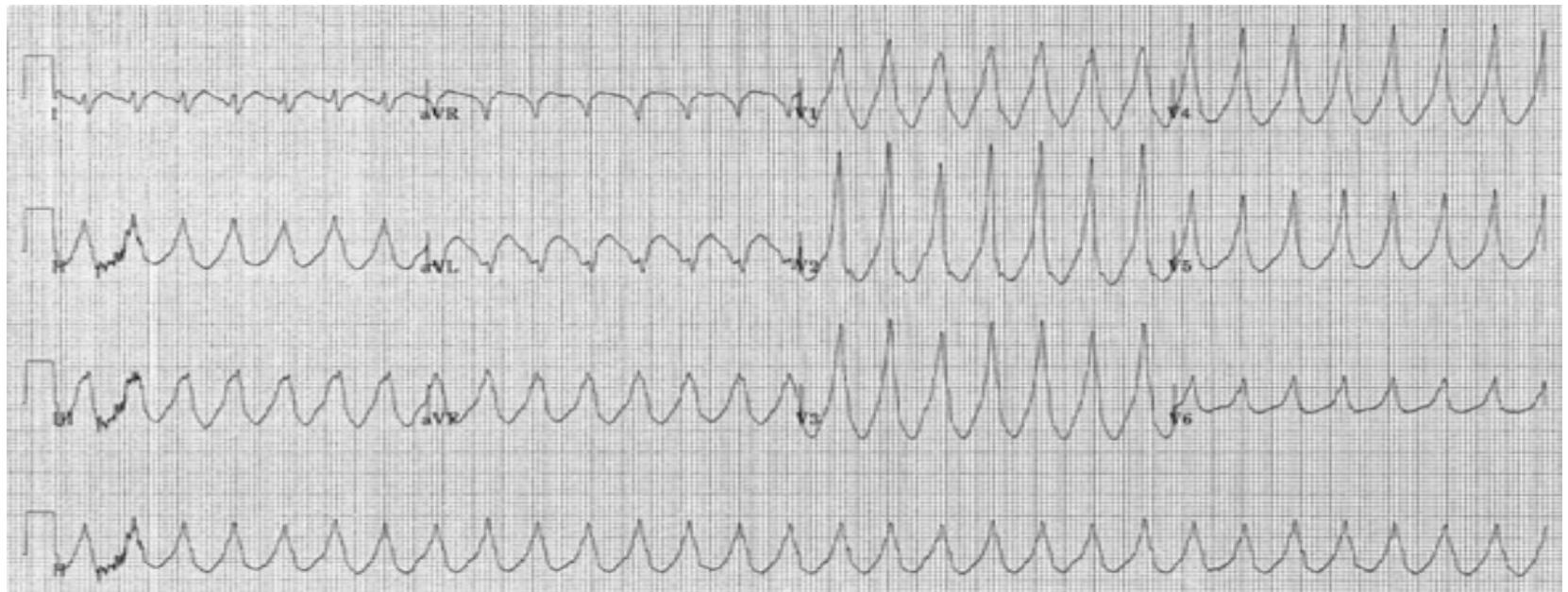
# 79yo man s/p NSTEMI



What is the rhythm?

What is the management?

# Ventricular Tachycardia



- Rapid and regular
- No P waves
- Wide QRS complexes

# Ventricular Tachycardia

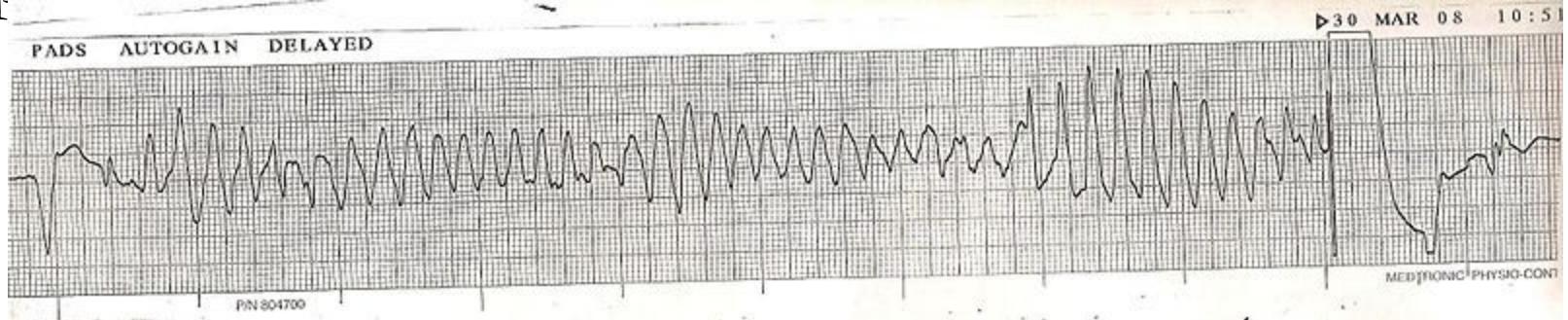
- Monomorphic VT



Ksheka, [Wikimedia Commons](#)



- Polymorphic VT



Displaced, [Wikimedia Commons](#)

# Ventricular Tachycardia

- Assume any wide complex tachycardia is VT until proven otherwise
  - SVT with aberrant conduction may also have wide QRS complexes
- Attempt to establish the diagnosis
  - Ischemia risk and VT go together

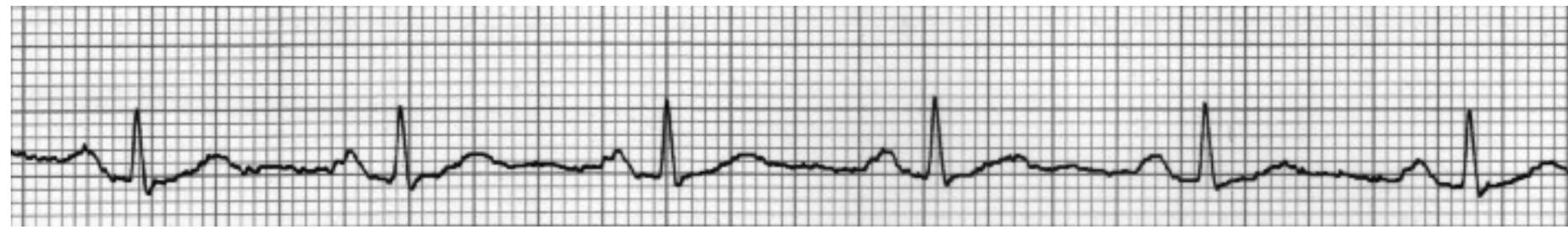
# Treatment of VT

- If pulseless - follow VF algorithm
- If stable try anti-arrhythmics
  - Amiodarone
  - Lidocaine
  - Procainamide?
- If patient has a pulse, but is unstable or not responding to meds - shock

# Treatment of VT

- Anti-arrhythmics are also pro-arrhythmic
- One antiarrhythmic may help, more than one may harm
- Anti-arrhythmics can impair an already impaired heart
- Electrical cardioversion should be the second intervention of choice

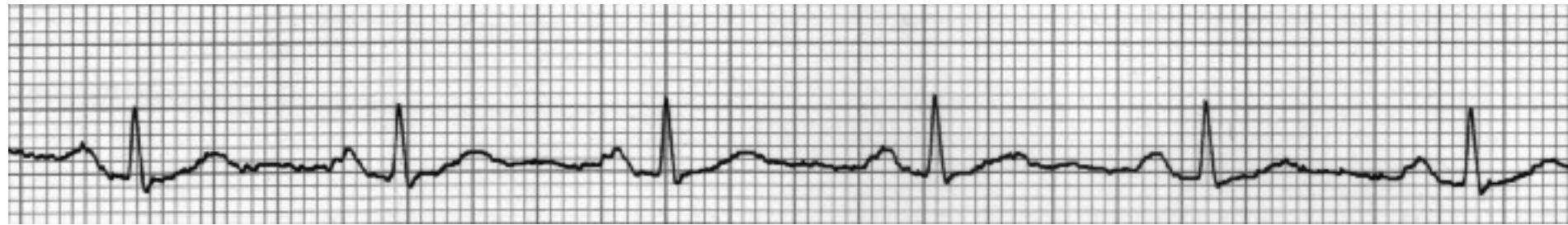
# 60yo diabetic man with chest pain



What is the rhythm?

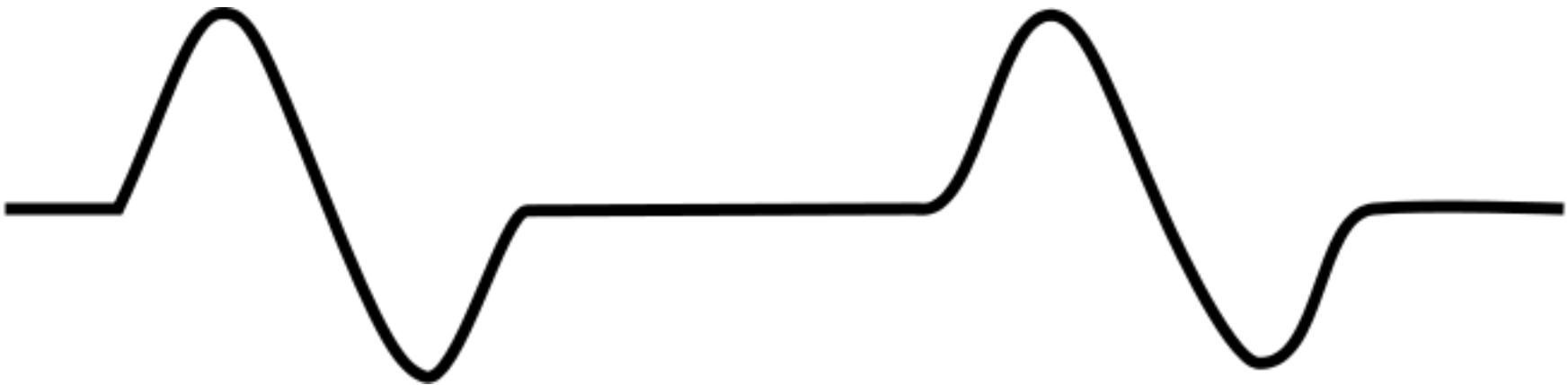
What is the management?

# Normal Sinus Rhythm



- Regular rate and rhythm
- Normal P waves and QRS
- Evaluate for cause of chest pain and monitor for change in rhythm

40 yo woman found down, pulseless and  
apneic



What is the rhythm?

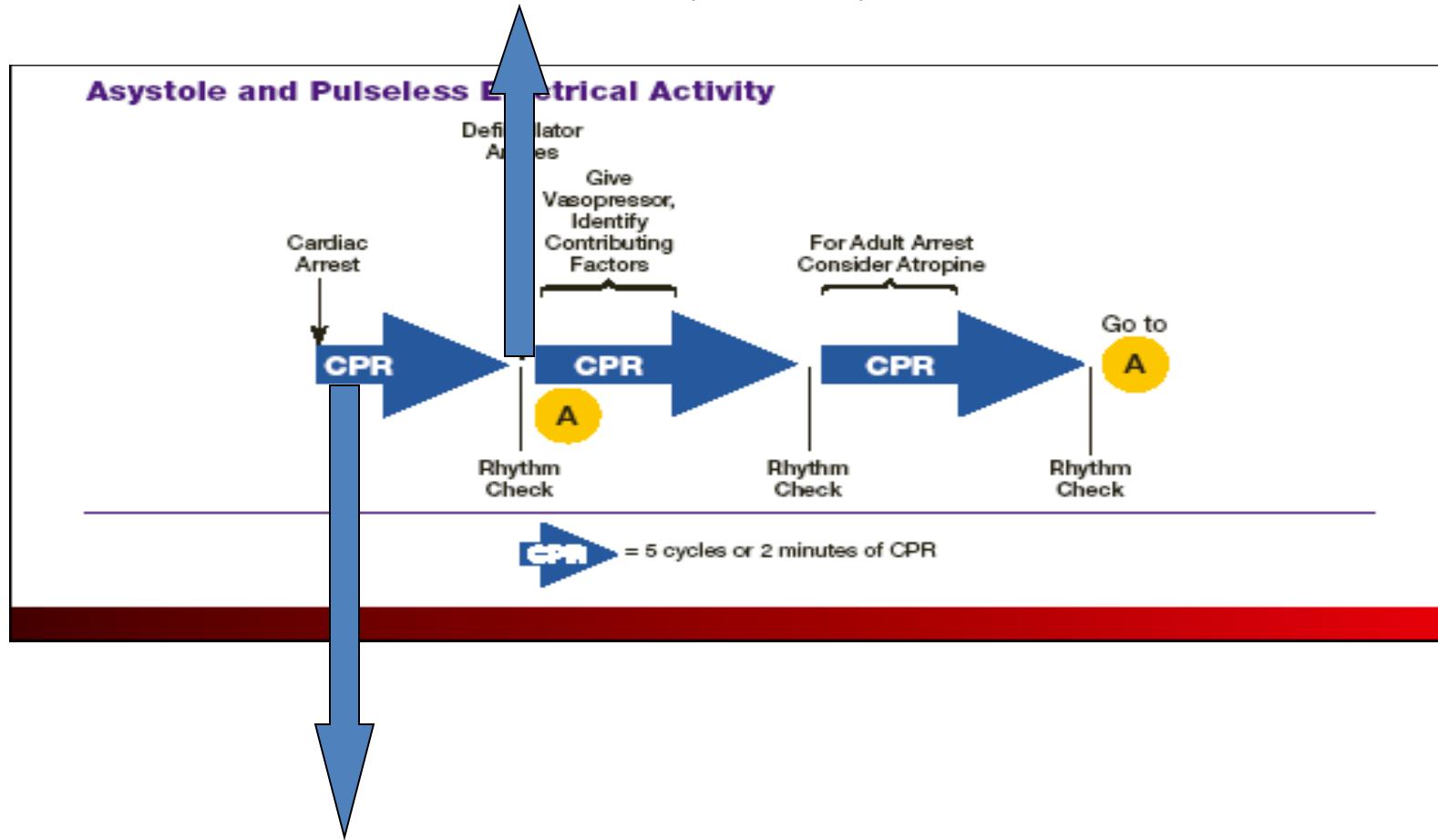
What is the management?

# Pulseless Electrical Activity

- Any organized (or semi-organized) electrical activity in a patient without a detectable pulse
- Non-perfusing
- Treat the patient NOT the monitor
- Find and treat the cause!!!!

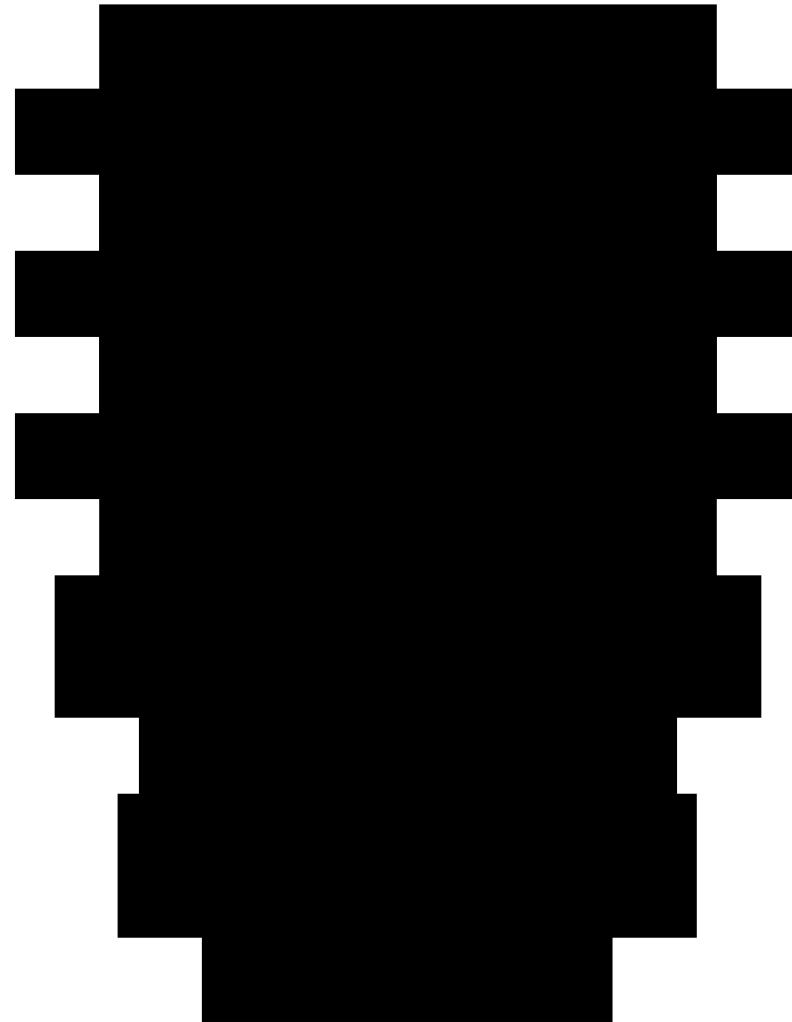
# PEA and Asystole

## Secondary Survey - ABCD



## Primary Survey - ABC

# PEA



# Find and Treat the Cause

- Non-shockable rhythm
- The **most** effective treatment is to find and fix the underlying problem



# So what causes PEA?

- #1 cause of PEA in adults is hypovolemia
- #1 cause in children is hypoxia/respiratory arrest
- Other causes?

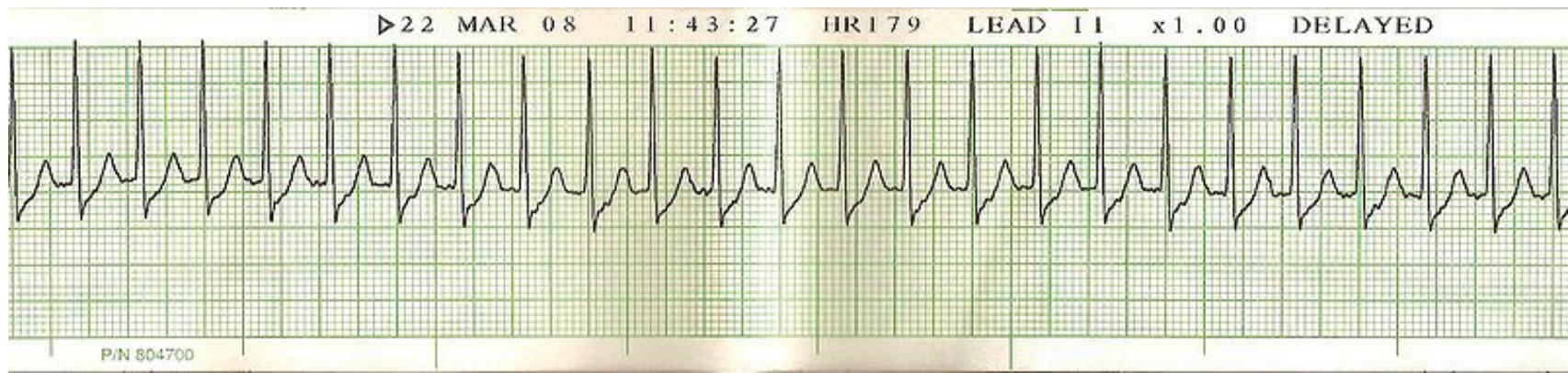
# The H's and T's

- **Hypovolemia**
- **Hypoxia**
- Hydrogen ion (acidosis)
- Hyper-/hypokalemia
- Hypothermia
- Hypoglycemia (rare)
- Toxins
- Tamponade
- Tension pneumothorax
- Thrombosis (coronary or pulmonary)
- Trauma

# Treat the H's and T's

- Hypovolemia
  - Volume – IVF, PRBC's
- Hypoxia
  - Oxygenate/Ventilate
- Hydrogen ion (acidosis)
  - Sodium bicarbonate
  - Hyperventilation
- Hyper-/hypokalemia
  - Sodium bicarbonate
  - Insulin/glucose
  - Calcium
- Hypothermia
  - Warm -- invasive
- Hypoglycemia
  - Dextrose
- Toxins
  - Check levels
  - Charcoal
  - Antidotes
- Tamponade
  - pericardiocentesis
- Tension pneumothorax
  - Needle decompression
  - Tube thoracostomy
- Thrombosis (coronary or pulmonary)
  - Thrombolytics
  - OR/cath lab
- Trauma

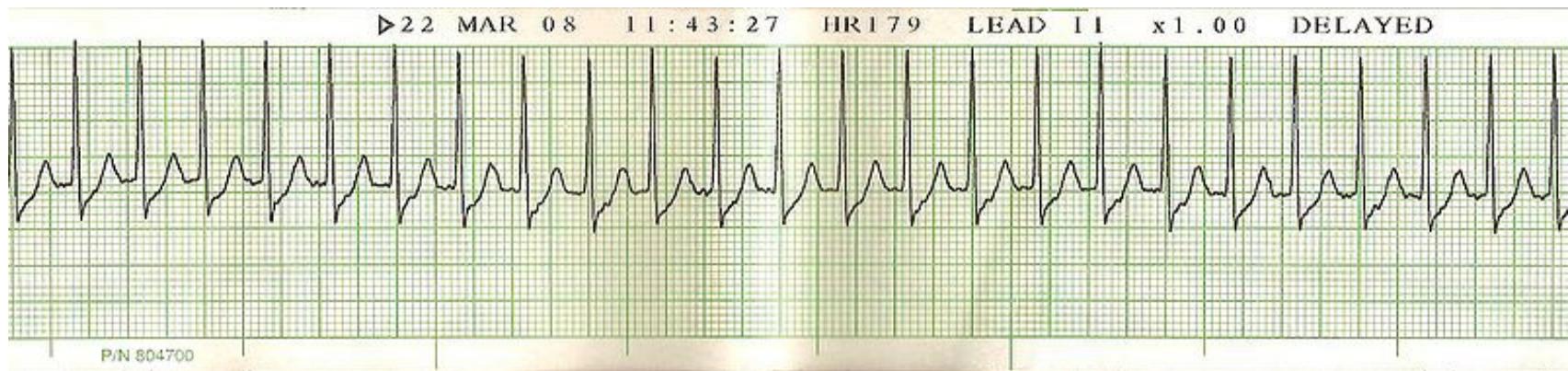
# 19yo man with palpitations



What is the rhythm?

What is the management?

# Supraventricular Tachycardia



- Rapid (usually 150-250 bpm) and regular
- P waves cannot be positively identified
- QRS narrow

# Treatment of Stable SVT

- Consider vagal maneuvers
  - Carotid sinus massage
  - Valsalva
  - Eyeball massage
  - Ice water to face
  - Digital rectal exam
- Adenosine
  - 6 mg, 12 mg, 12 mg

# Treatment of Unstable SVT

- Electrical Cardioversion
- Cardioversion is not defibrillation
- Use defibrillator in “sync” mode
  - prevents delivering energy in the wrong part of the cardiac cycle (R on T phenomenon)

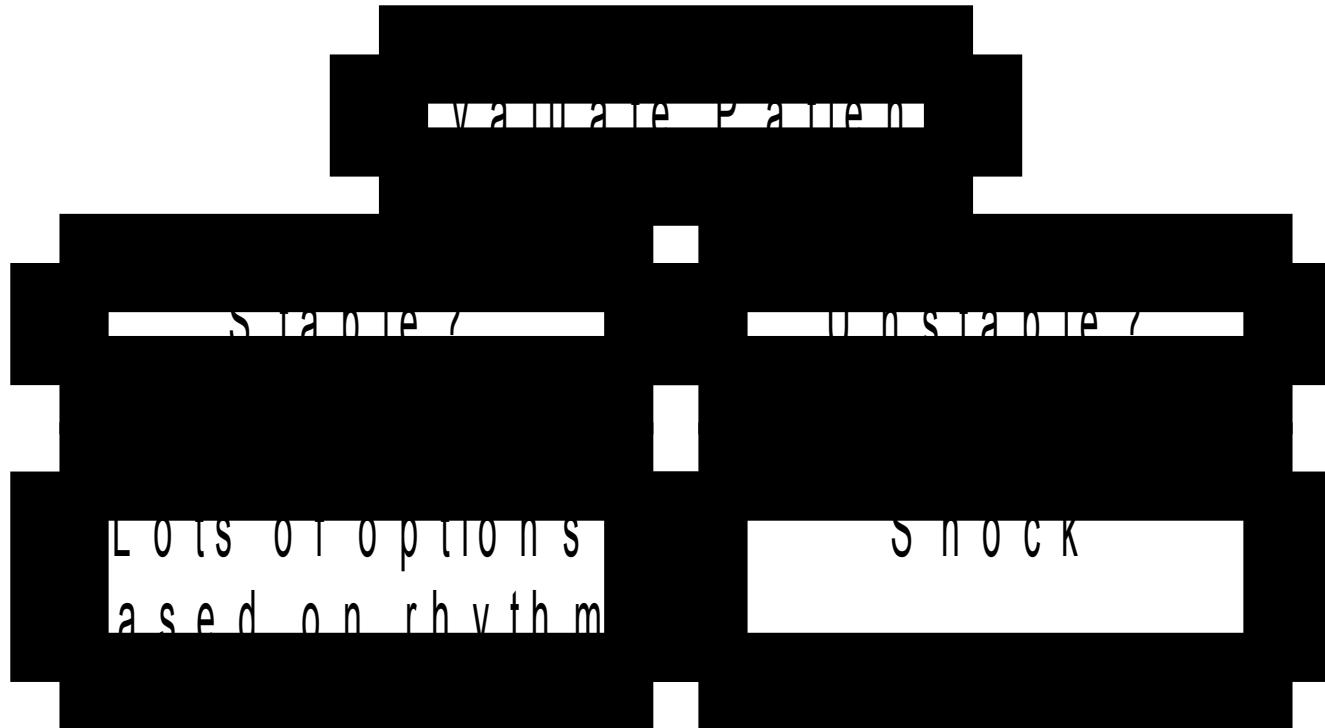
# Electrical Cardioversion

- Energy level – somewhat controversial
- 100 J → 200J → 300J → 360J
- Atrial flutter may convert with lower energy
  - 50J
- For polymorphic VT – start with 200J
- The EP guys tend to start with 360J

# Electrical Cardioversion

- Be prepared
  - Patient on monitor, IV, Oxygen
  - Suction ready and working
  - Airway supplies ready
- Pre-medicate whenever possible
  - Conscious sedation
  - Electrical shocks are painful!

# Tachycardia

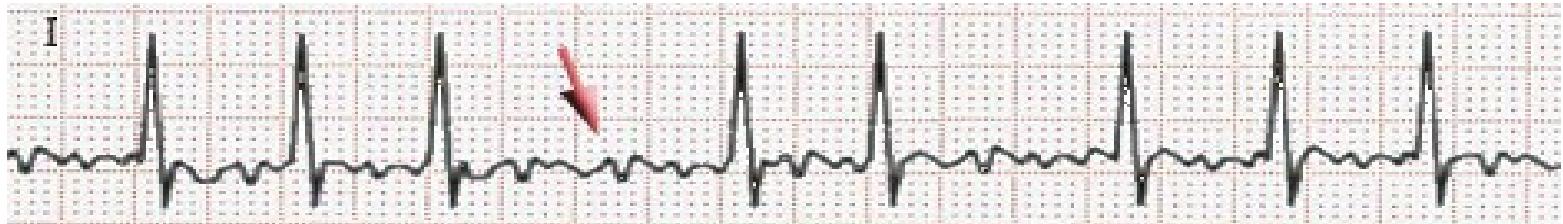


- Treat the patient NOT the monitor!!!

# Stable Tachycardias

- Narrow complex?
  - Regular rhythm
    - Sinus tachycardia
    - SVT
    - AV nodal reentry
  - Irregular rhythm
    - Atrial fibrillation
    - Atrial flutter
- Wide complex?
  - Uncertain rhythm – assume VT
  - Narrow complex tachycardia with aberrancy
  - Ventricular tachycardia
    - Monomorphic or polymorphic

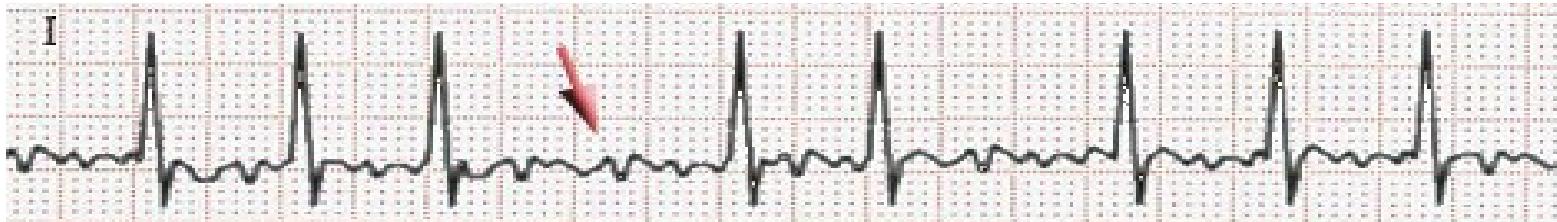
# 56 yo woman with shortness of breath and chest pain



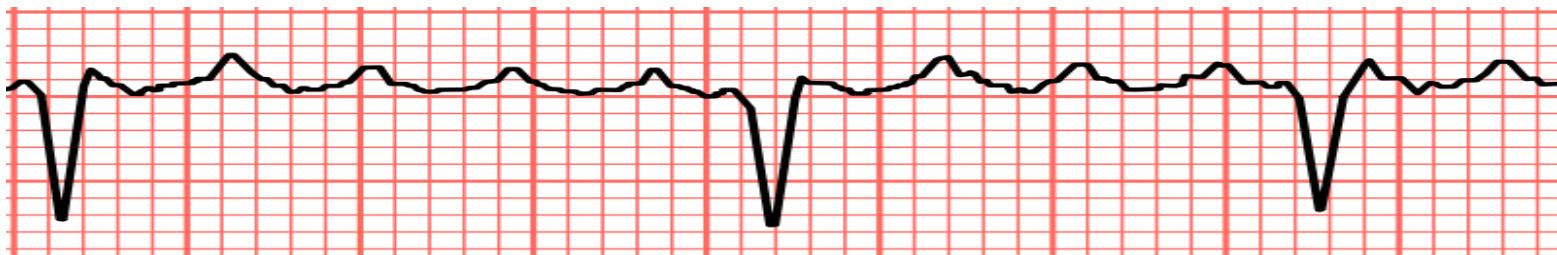
What is the rhythm?

What is the management?

# Atrial fibrillation/flutter



J. Heuser, [Wikimedia Commons](#)



James Heilman, MD, [Wikimedia Commons](#)

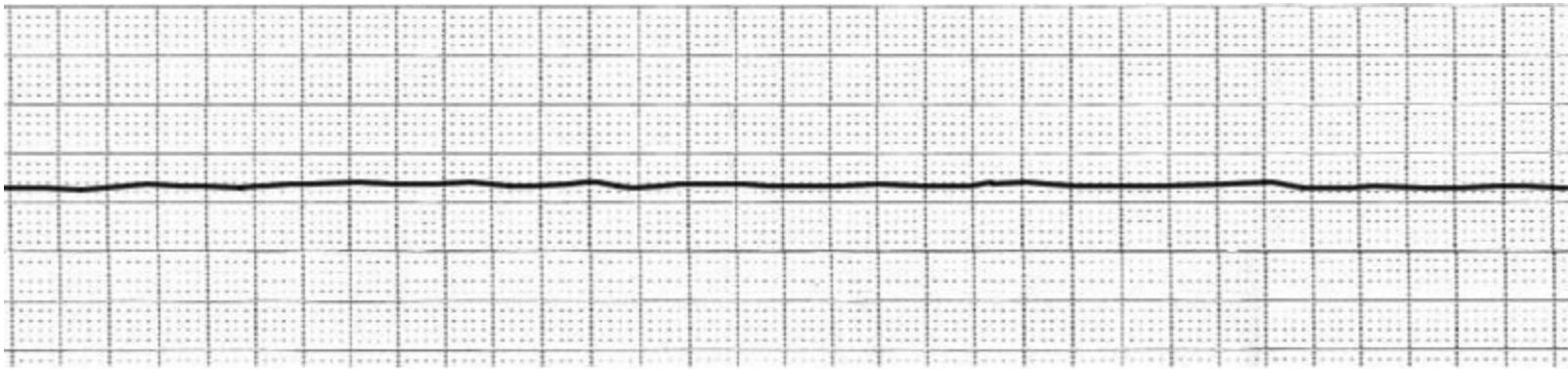


- May be rapid
- Irregular (fib) or more regular (flutter)
- No P waves, narrow QRS

# Atrial fibrillation/flutter

- Treatment based on patient's clinical picture
  - Unstable = Immediate electrical cardioversion
  - Stable
    - Control the rate
      - Diltiazem
      - Esmolol (not if EF < 40%)
      - Digoxin
    - Provide anticoagulation
- Treat the patient NOT the monitor!!!

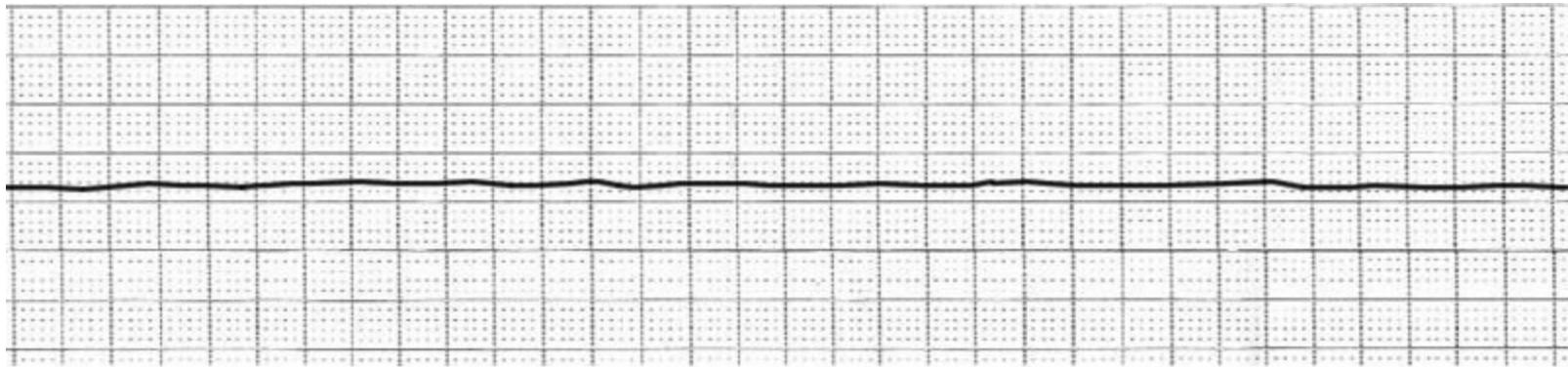
78yo man found down, pulseless and  
apneic, unknown duration



What is the rhythm?

What is the management?

# Asystole



- Is it really asystole?
- Check lead and cable connections.
- Is everything turned on?
- Verify asystole in another lead.
- Maybe it is really fine v-fib?

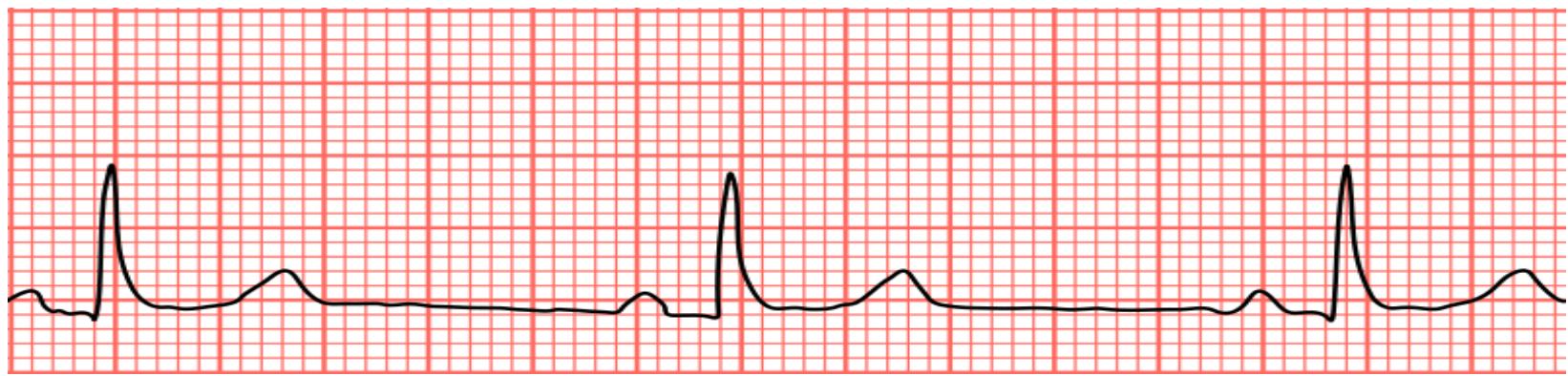
68 yo woman with h/o hypertension  
presents with dizziness



What is the rhythm?

What is the treatment?

# Sinus Bradycardia



- Slow and regular
- Normal P waves and QRS complexes

# Bradycardias

- Many possible causes
  - Enhanced parasympathetic tone
  - Increased ICP.
  - Hypothyroidism
  - Hypothermia
  - Hyperkalemia
  - Hypoglycemia
  - Drug therapy

# Bradycardias

- Treat only **symptomatic** bradycardias
  - Ask if the bradycardia causing the symptoms
- Recognize the **red flag** bradycardias
  - Second degree type II block
  - Third degree block

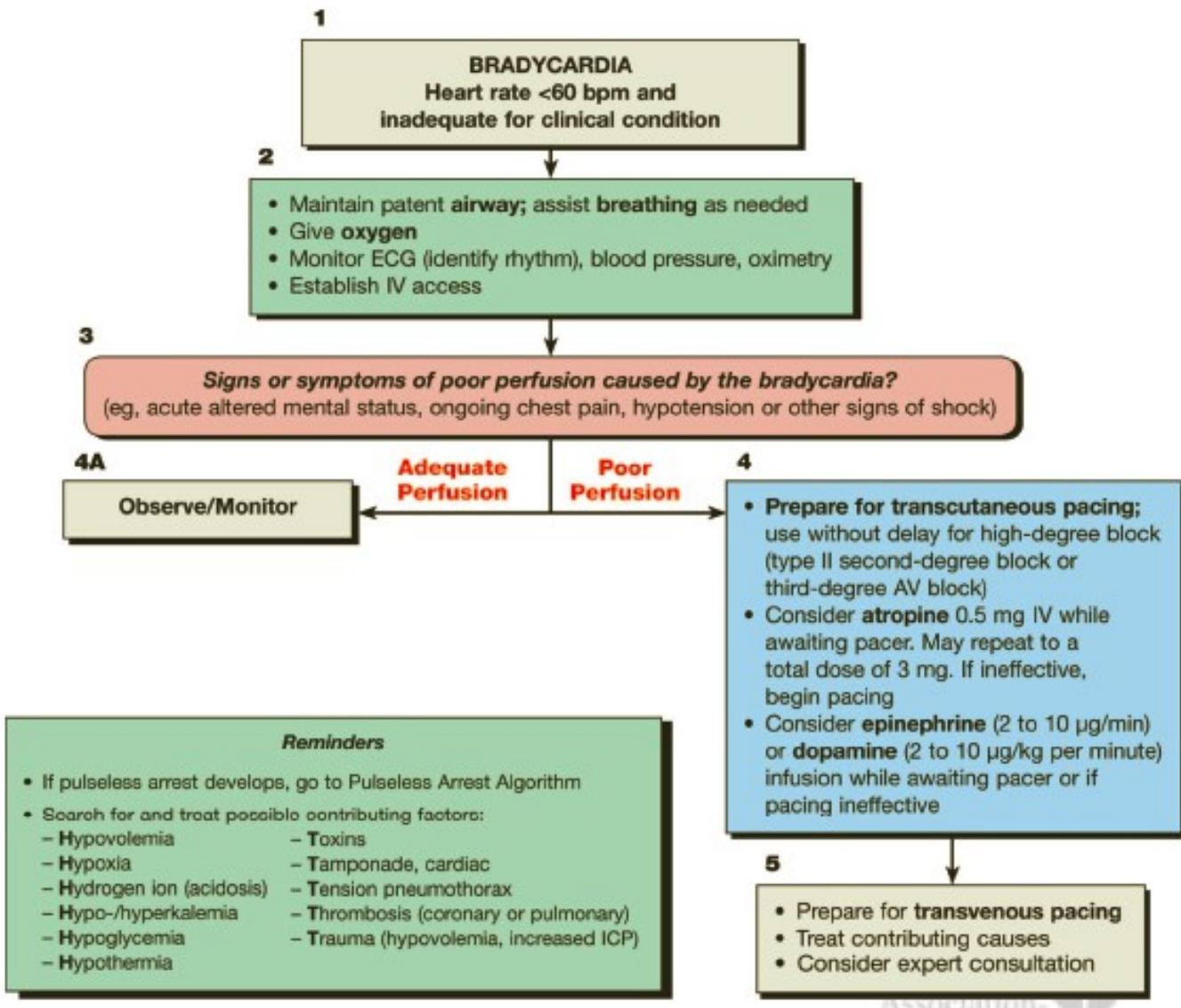


Figure 1. Bradycardia Algorithm. Fighting Heart Disease and Stroke

# Transcutaneous pacing

- Class I for all symptomatic bradycardias
- Always appropriate
- Doesn't always work
- Technique
  - Attach pacer pads
  - Set a rate to 80 bpm
  - Turn up the juice (amps) until you get capture
- Painful – may need sedation / analgesia

# Transvenous Pacing

- Invasive
- Time-consuming to establish
- Skilled procedure
- Better long-term than transcutaneous
- May have better capture than transcutaneous pacing

# Bradycardia Treatment

- Medications
  - Vagolytic
    - Atropine
  - Adrenergic
    - Epinephrine
    - Dopamine

# What if the same patient had this rhythm?



What is the rhythm?

What is the treatment?

# Junctional Escape



- Slow and relatively regular
- No P waves
- Narrow QRS
- Arises from site near the junction of the atria and ventricles

# 29 yo asymptomatic female



What is the rhythm?

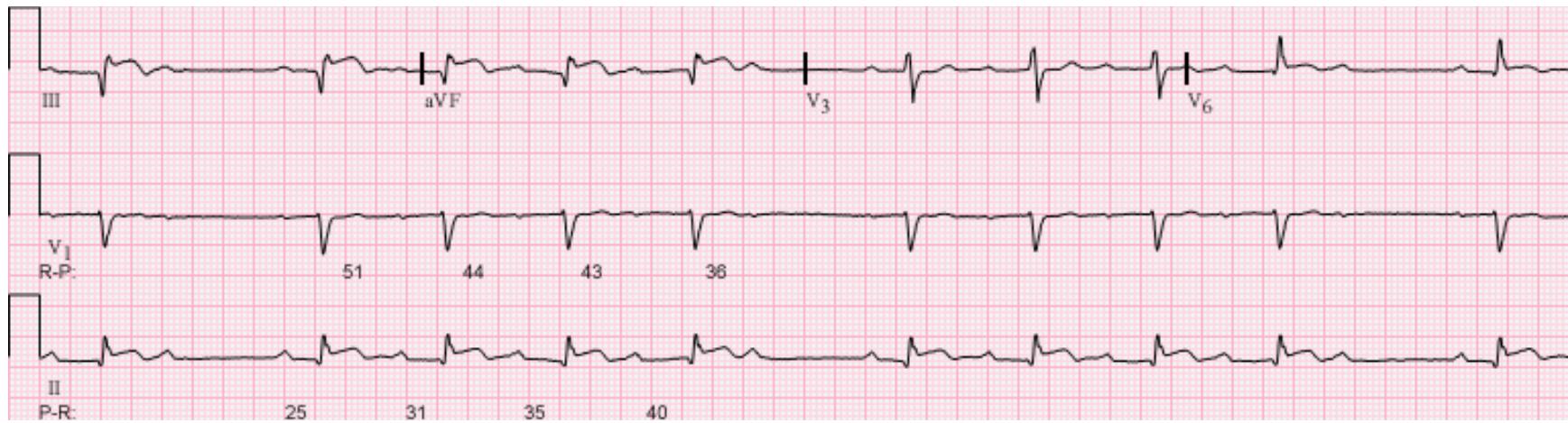
What is the management?

# $1^\circ$ AV block



- Regular rate and rhythm
- Normal P wave with long PR interval ( $>0.2\text{msec}/1$  big box)
- Normal QRS

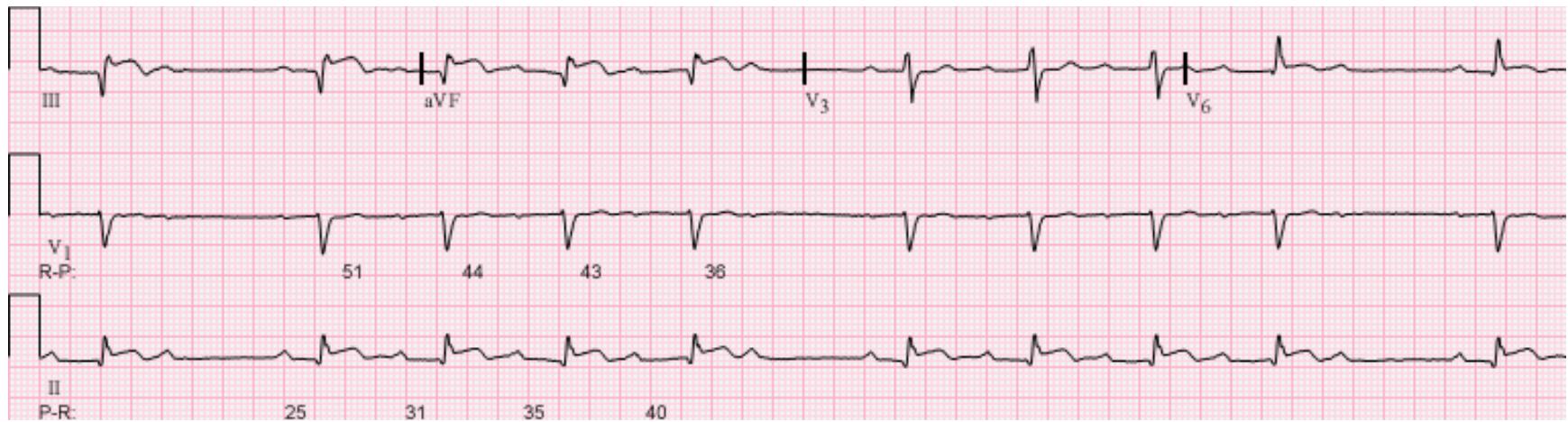
# 58yo asymptomatic woman



What is the rhythm?

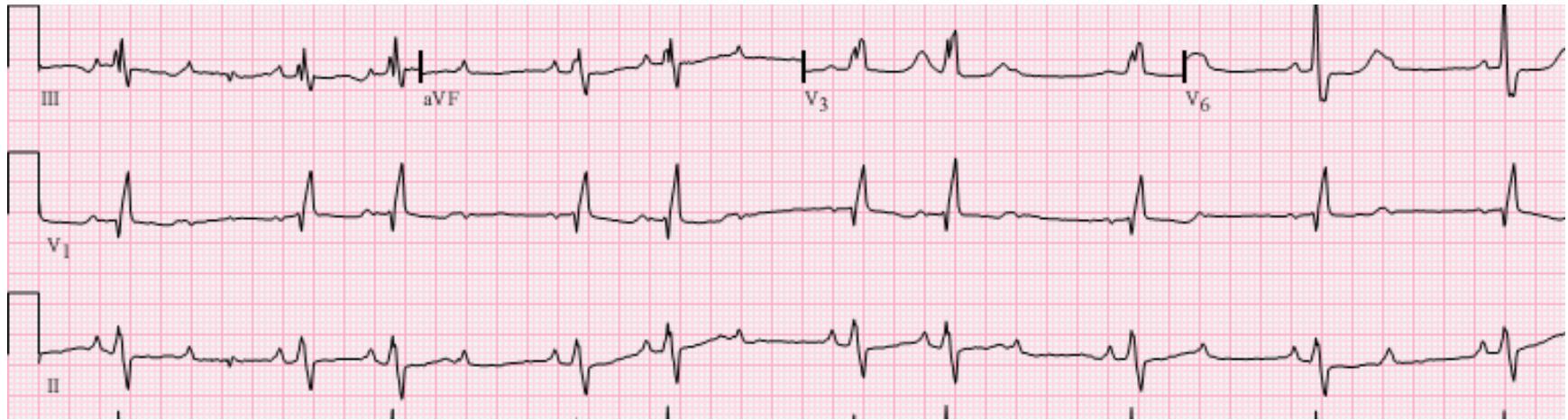
What is the management?

# 2° AV Block - Type I



- aka Wenckebach
- Regular rate and rhythm
- Normal P waves and QRS complexes
- Increasing PR interval until QRS dropped

# 80 yo man with syncope



What is the rhythm?

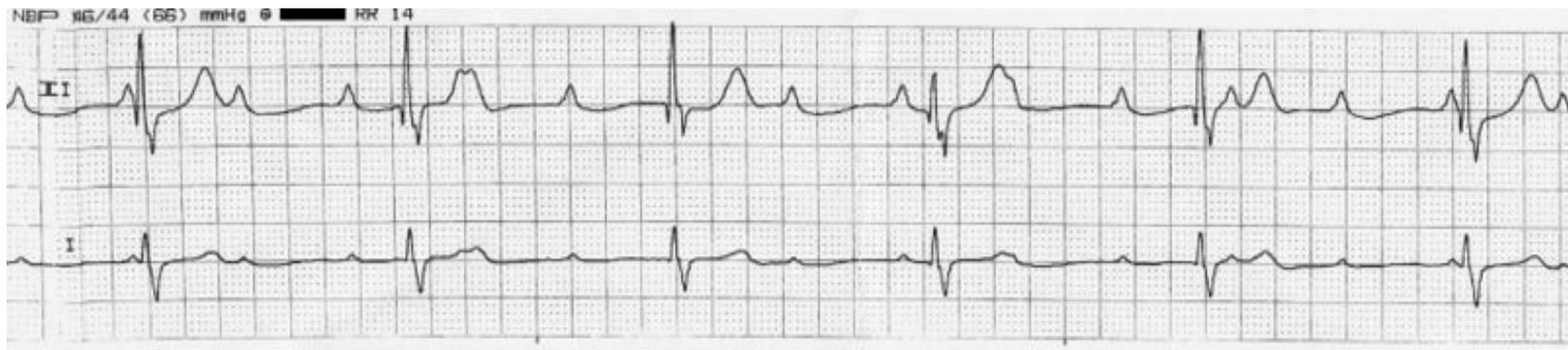
What is the management?

# 2° AV Block – Mobitz Type II



- Regular atrial rate with normal P wave
- Consistent PR interval
- Random QRS dropped

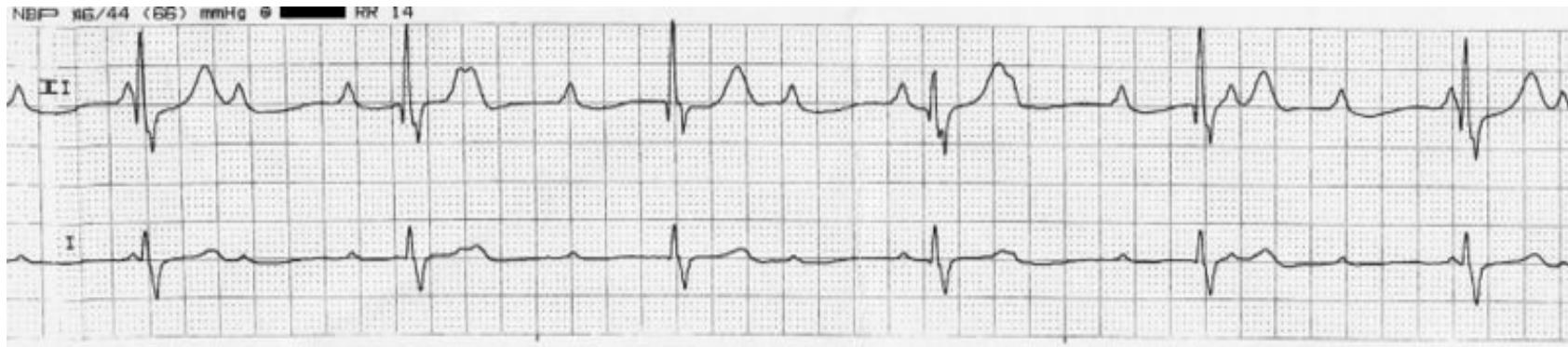
# Another 80 yo man with syncope



What is the rhythm?

What is the management?

# $3^{\circ}$ AV Block



- Normal P waves
- Normal QRS
- No relationship between P and QRS
- aka complete heart block

# Know When To Stop

- With return of spontaneous circulation
- No ROSC during or after 20 minutes of resuscitative efforts
  - Possible exceptions include near-drowning, severe hypothermia, known reversible cause, some overdoses
- DNR orders presented
- Obvious signs of irreversible death

# Take Home Points

- Assess and manage at every step **before** moving on to the next step
- Rapid defibrillation is the **ONLY** effective treatment for VF/VT
- Search for and **treat** the cause
- Treat the patient **not** the monitor
- Reassess frequently
- Minimize interruptions to chest compressions

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Suzanne Dooley-Hash, MD  
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