Management of Cardiac Arrest

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Objectives

- Identify causes of cardiac arrest
- Identify the four ECG presentations of cardiac arrest
- Review high quality CPR
- Discuss “best practices” in cardiac arrest management
- Review use of induced hypothermia for ROSC patients

What's the definition of cardiac arrest?

<u>Cardiac Arrest</u>

A medical emergency with absent or inadequate contraction of the left ventricle of the heart that immediately causes body wide circulatory failure.

- Acute myocardial infarction
- Ischemia without infarction
- Structural alterations such as scar formation or ventricular dilation secondary to prior infarction

Incidence….

- Each year, 424,000 people experience non-traumatic OHCA
- Approximately 60 percent of OHCA victims are treated by EMS
- Twenty-five percent of OHCA victims treated by EMS have no symptoms before the onset of arrest
- For EMS-treated OHCA cases, 23 percent have an initial rhythm of VF or VT
  - May respond well to treatment with AED

Initial Rhythm Presentation

- Initial rhythm in primary cardiac arrest

Initial Rhythm	Occurrence
VF	50%
Asystole	30%
PEA	18%
VT	2%

- Out of hospital cardiac arrests (OHCA) 20% reach the ED and 8% survive past discharge

Risk

- Age-adjusted incidence of OHCA is higher among blacks and Hispanics than among whites
- Prior heart disease (myocardial infarction or heart failure) is a major risk factor for cardiac arrest
- A family history of cardiac arrest in a parent, sibling, or offspring is associated with a ***two-fold*** increase in risk of cardiac arrest.

Sports: Rising Number of Cardiac Arrests

- Physical activity/exercise can reduce the risk of cardiac arrest
  - When coupled with undiscovered congenital factors
- Media attention is being given to student athletes with pre-existing cardiac conditions
  - Helps raise awareness for early cardiac screenings

Outcomes

- Outcomes are rhythm dependent
- VT – 80% reach hospital and 70% survive
- VF - 40% reach hospital and 20% survive
- PEA -10% reach hospital and 1% survive
- Asystole – 5% reach the hospital and 1% survive

Go AS, Mozaffarian D, Roger VL, et al. (2013) Circulation. 129:e28-e292

Sudden Cardiac Arrest Survival

- Survival to hospital discharge after EMS-treated non-traumatic cardiac arrest with any first recorded rhythm is 10.4 percent
- Survival after bystander-witnessed VF is 31.7 percent
- Among people who survive to hospital discharge, five-year survival is better among those who received angioplasty compared with their counterparts (78.7 vs. 54.4 percent)
- Among those who receive therapeutic hypothermia compared with their counterparts (77.5 vs. 60 percent).
- Survival rates are higher among those who receive chest compressions alone (10.2 percent) vs. chest compressions and rescue breathing (8.5 percent).
- Rates of survival to 30 days after hospital discharge are more than twice as poor for blacks as for whites. Survival among Hispanics are also lower than among whites.

Risk Factors Associated with Cardiac Arrest

- Age
- HTN
- Heart Disease
- Diabetes Mellitus
- Obesity
- Renal Failure
- Genetic predisposition
- Social factors
  - Smoking
  - Alcohol

Physiological/Disease Specific Risk Factors

Common

- Coronary Artery Disease
- Cardiomyopathies

Uncommon

- Aortic Stenosis
- Congenital heart disease
- Wolf Parkinson-White
- Prolonged QT
- Brugada Syndrome

Risk Factors of Cardiac Arrest

A Confluence Of Risk Factors Act Together To Produce Sudden Cardiac Death

- **Transient risk factors**
- Ischemia
- Hypoxia
- Hypotension
- Acidosis
- Electrolyte imbalances
- Drug effects
- **SCD**

Risk

- **Etiology**
  - CAD ~ 80%
  - Cardiomyopathies ~ 15%
  - WPW syndrome < 5%
  - Genetic factors < 5%
  - Long-term medical problems (coronary artery disease and cardiomyopathies) produce structural pathology in the myocardium on which transient factors act and trigger ventricular tachycardia and ventricular fibrillation.

Four Initial ECG Rhythms of Cardiac Arrest

- Ventricular Fibrillation (VF)
- Pulseless Ventricular Tachycardia (VT)
- Pulse-less Electrical Activities (PEA)
- Asystole

Pathology of Cardiac Arrest

- General progression through several cardiac rhythm disturbances prior to an arrest…

V-Tach
- With pulse
- Without pulse

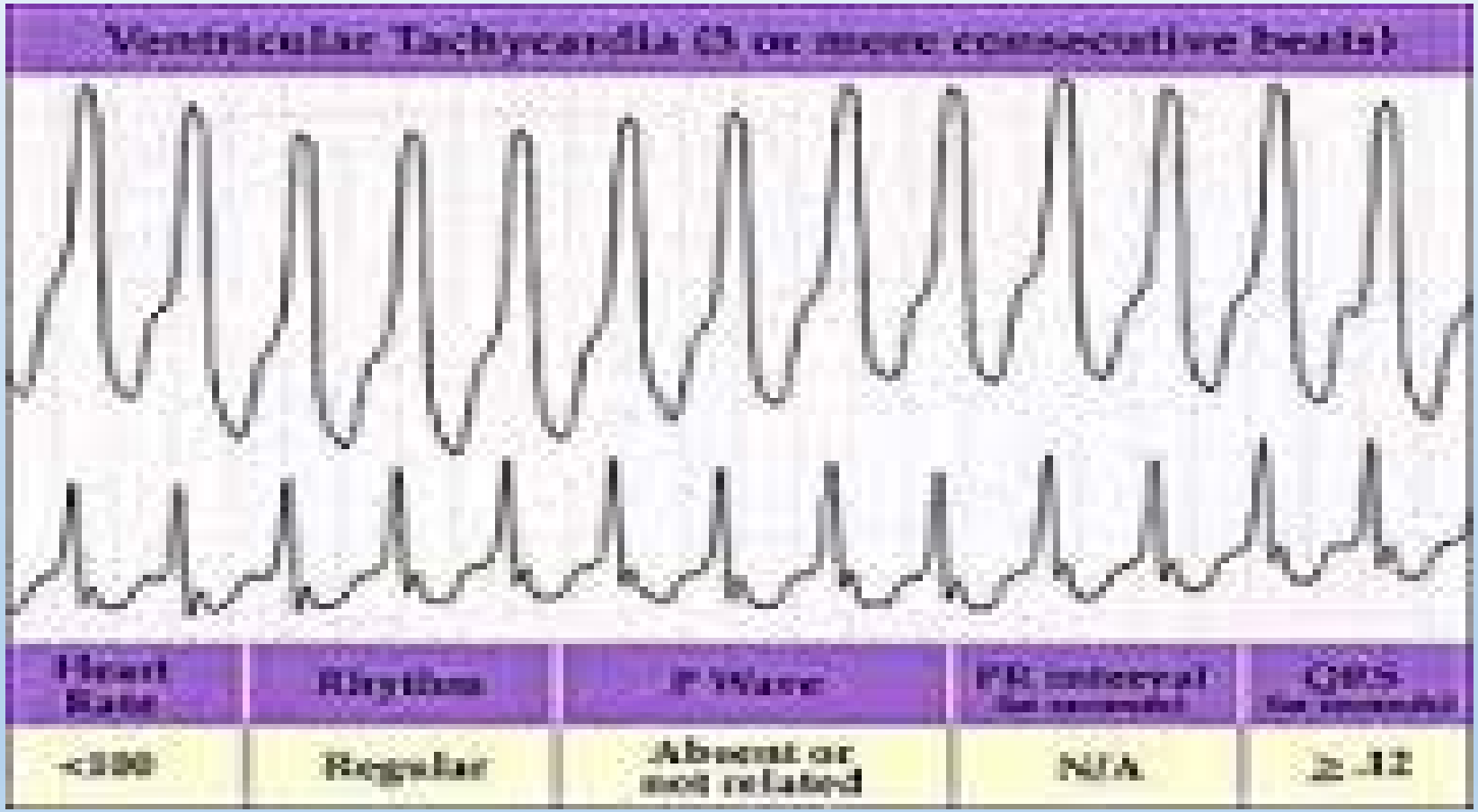
V-Fib
- Course: early in onset
- High survival potential!

PEA
- Poor prognosis for survival
- Same as Asystole

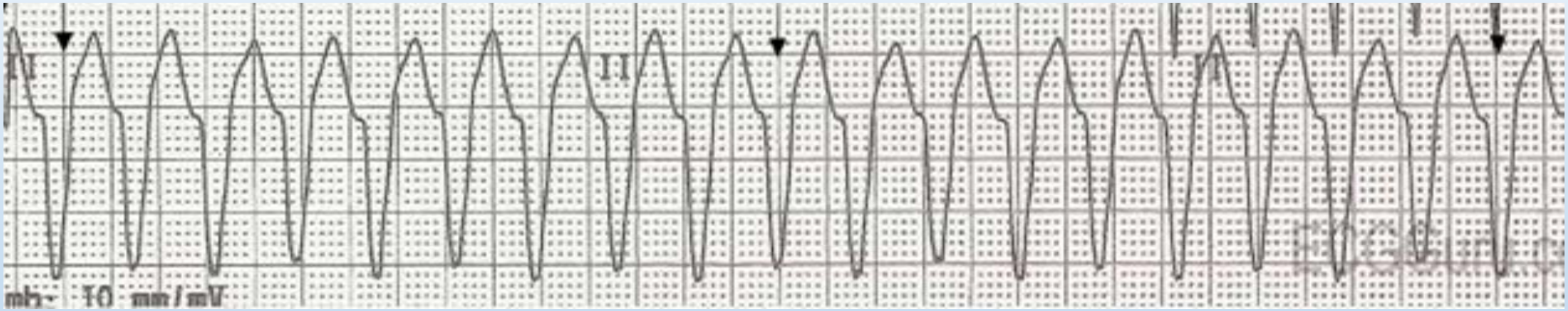
Asystole
- Poor prognosis for survival
- Same as PEA

Ventricular Tachycardia – V Tach

- Organized Chaos of a ventricular origin
- No perfusion
- Treat with defibrillation and medication



V Tach

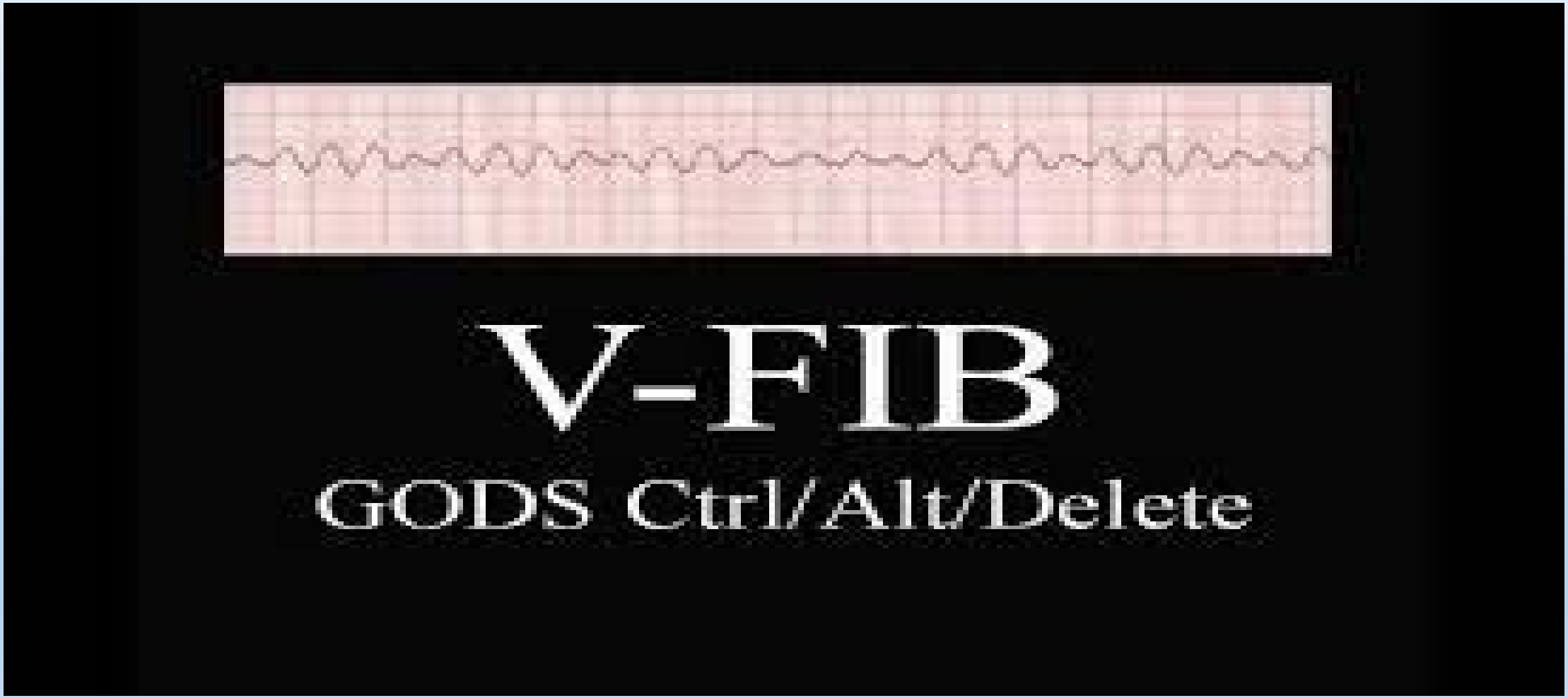


Torsade's

"Twisting around a point"
Usually kicked off by a PVC……..

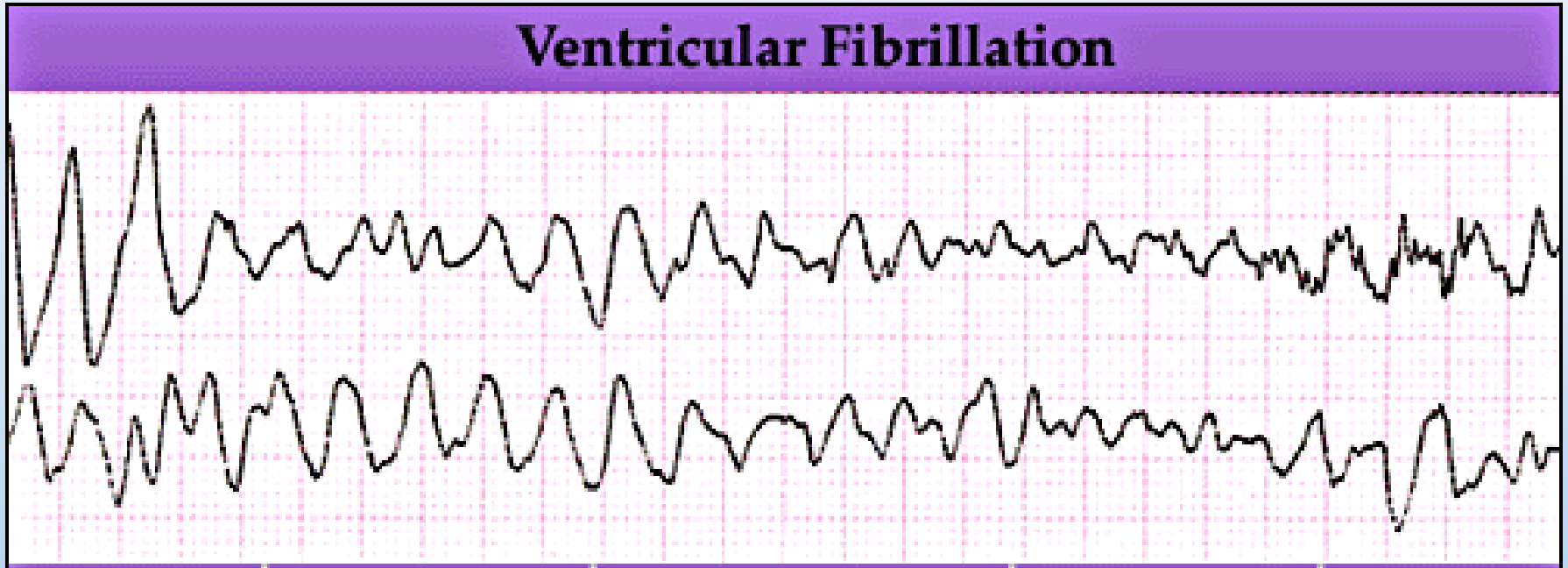
- Consider cause
- Consider magnesium

Ventricular Fibrillation



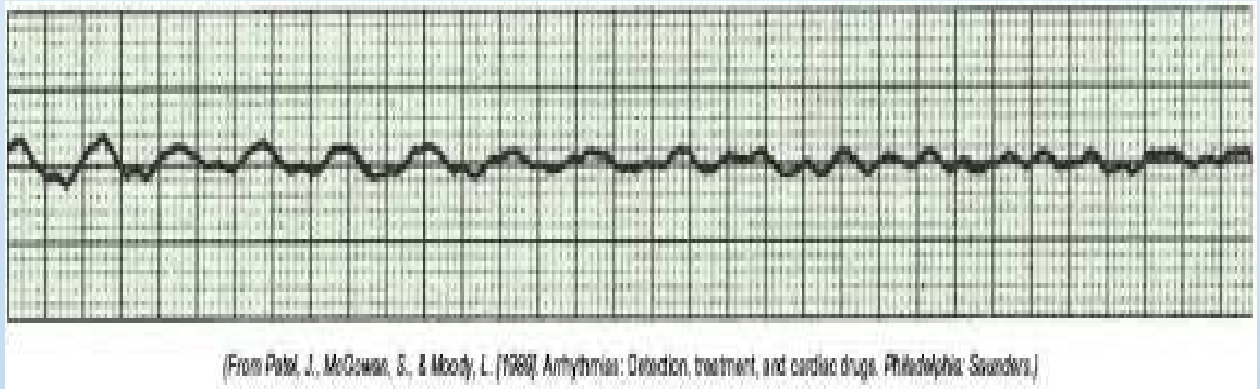
Ventricular Fibrillation

- Chaotic rhythm
- No perfusion
- Treat with defibrillation and medication



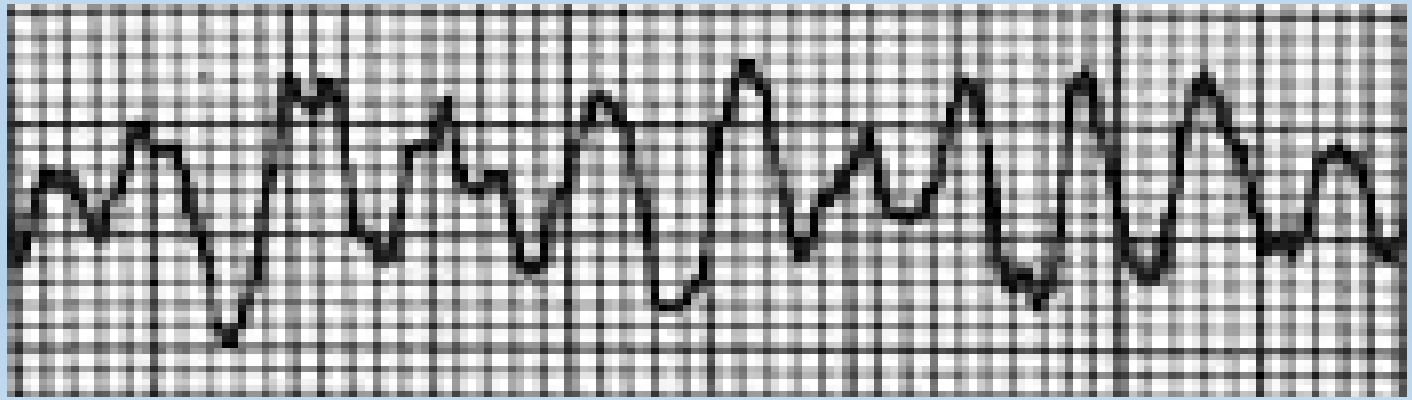
Heart Rate	Rhythm	P Wave	PR interval (in seconds)	QRS (in seconds)
300-600	Extremely irregular	Absent	N/A	Fibrillatory baseline

V Fib



Fine V Fib

Course V Fib

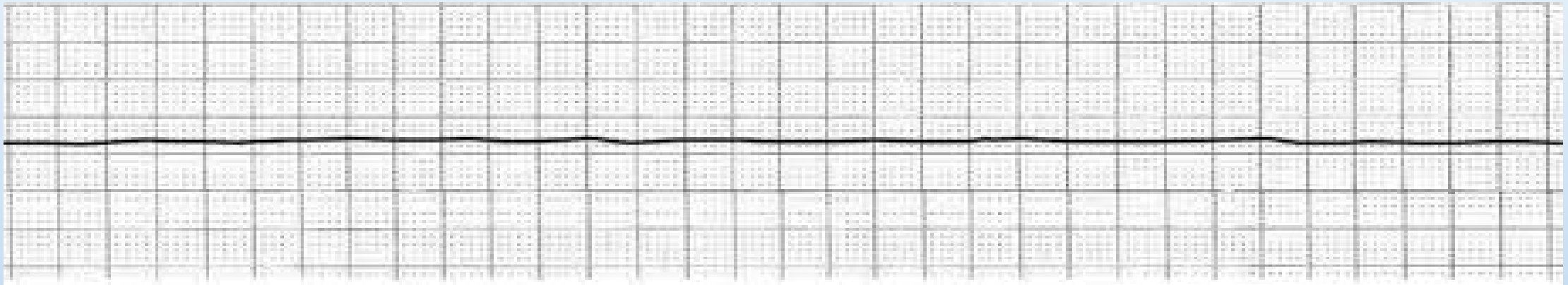


Pulseless Electrical Activity – PEA

- Search for the underlying causes
  - Hypovolemia
  - Hypoxia
  - Hypoglycemia
  - Hydrogen ions (acidosis)
  - Hypothermia
  - Hypo-/hyperkalemia
  - Tension pneumothorax
  - Tamponade
  - Thrombosis
  - Toxins

- CPR and Epinephrine. But also try a fluid bolus or a warm blanket. In the case of PEA, sometimes simple is better.

Asystole



Cardiac Standstill

- Treatment includes medications and continuous High Quality CPR

Treatment for Presenting Dysrhythmias

- It is always

High Quality CPR

CPR “Chain of Survival”

- Immediate recognition of cardiac arrest and activation of EMS
- Early CPR with emphasis on chest compression
- Rapid defibrillation
- Effective advanced life support
- Integrated post-cardiac arrest care

AHA Out of Hospital Cardiac Arrest Reports…

- More than 1,000 people suffer non-traumatic cardiac arrest outside hospitals—including about 26 children—each day in the U.S.
- Overall survival rates are approximately 10 percent.
- Among young victims, the survival rate is about five percent.

AHA – Heart Disease and Stroke Statistics

Incidence and Outcome of Out-of-Hospital Cardiac Arrest in the U.S.

	Annual number of cases	Annual number of fatalities	Survival, (%)
EMS assessed			
Overall	424,000	401,000	5.2
Children	9,500	8,800	4.4
EMS treated			
Overall	211,000	187,000	10.4
Children	7,700	7,000	5.4
Shockable rhythm			
Overall	42,000	30,000	28.3
Children	560	370	26.7
Bystander-witnessed, shockable rhythm			
Overall	24,000	16,000	31.7
Children	240	160	26.7

Sudden Cardiac Arrest Foundation
raising awareness, saving lives

Summary by Sudden Cardiac Arrest Foundation.
Figures are point estimates.

Source: Resuscitation Outcomes Consortium Investigators, unpublished data, July 23, 2013.

Reference: American Heart Association Heart Disease and Stroke Statistics—2014 Update, http://circ.ahajournals.org/content/129/3/e28.

The Differential

Sudden cardiac death occurs in the setting of an acute insult acting most commonly on a pathological structural substrate

- Acidosis
- Acute myocardial infarction
- Cardiac tamponade, Tension pneumothorax
- Hypoxia, hypovolemia, hyperkalemia, hypokalemia hypoglycemia, hypothermia
- Pulmonary embolism
- Toxins or drugs

Differential….

Bedside Sonography

- Increasingly used by trained emergency physicians
- Check for cardiac activity in PEA/asystole
  - Pericardial effusion
  - Suspected aortic catastrophe

Differential……

- Hypoxia, hypovolemia, and hypoglycemia rapidly assessed
  - Treat with adequate ventilation, fluid resuscitation, and a finger stick test and dextrose water
- Hyperkalemia can cause bradycardic arrest, may or may not produce the typical ECG features of prolonged PR intervals and peaked T waves
  - Treat with 10 units of regular insulin with glucose in normoglycemic patients If hyperkalemia is detected prior to cardiac arrest, calcium gluconate, 10 mL in 10% solution over 10 to 20 minutes, should be given to stabilize electrical effects on cardiac myocytes

Differential……

Certain drugs can prolong the QT interval in genetically predisposed individuals. These medications include:19

- tricyclic antidepressants
- neuroleptics
- macrolide and quinolone antibiotics
- antifungal agents
- Procainamide
- quinidine
- sotalol

Differential…..

Cardiac tamponade

- Symptoms and signs prior to cardiac arrest (e.g. pulses paradoxus, elevated jugular venous pulsation, distant heart sounds
  - Emergent pericardiocentesis should be performed

Tension pneumothorax

  - Immediate decompression

Take the Time to Save a Life:

"…implementation of guidelines increasing the time devoted to chest compression during resuscitation."

- Minimum 100 compressions per minute
- Maximum 120 compressions per minute
- Compression IS important
- Allow FULL RECOIL of the chest to allow the heart to refill with blood to circulate on the next compression
- Take your weight off your hands….this requires practice

Did You Know?

"…implementation of guidelines increasing the time devoted to chest compression during resuscitation."

- It takes 16 seconds worth of compressions to obtain enough vascular pressure for oxygen exchange to occur within the cells of vital organs
- It only takes 3 seconds of no compressions to reduce that pressure back to "0"!!!
- Maintain your compressions while you ventilate

Changes: Ventilation

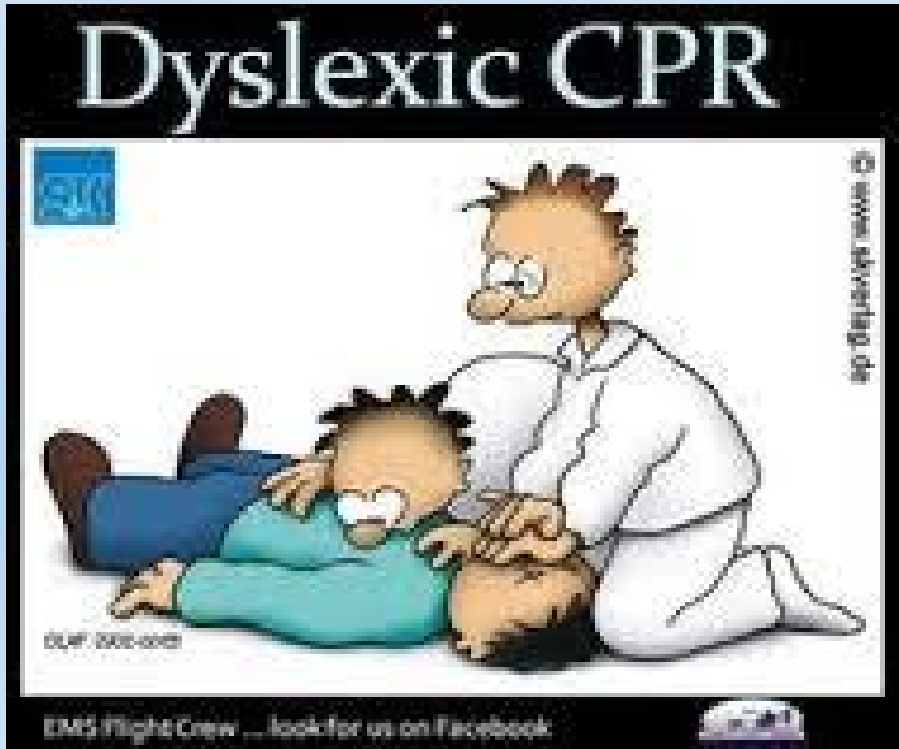
"*These changes include reducing the number of back-to-back rhythm analyses/shocks, eliminating rhythm and pulse checks after each shock, and increasing the ratio of chest compressions to ventilations.*"

- Get on the chest and STAY ON THE CHEST even after defibrillation!
- If rhythm converts to a "viable" rhythm after defibrillation STAY ON THE CHEST for one minute before assessing a pulse
- When using an AED only stop compressions when the machine tells you to
- Ventilate once every 5-6 seconds, or once every 20 compressions…NO MORE

Reality Check…

Hospital personnel are less proficient at CPR than we are at ACLS

- Why?
  - We worry about the “next” intervention
  - We do too much ALS before BLS
  - We spend to much time on ET/IV/IO insertions
  - We think we “already know this”!



Frequency of Use

How many of you could be experts at anything you only practice 15.6% of the time?

Improving CPR outcomes

<u>Best Practices</u>

- The goal is to save lives
- If the rhythm is shockable – Stay and Play
- If the rhythm is not-shockable – Continue High Quality CPR

Are you still going to halt definitive resuscitation to:

- Move them onto a board
- Onto the stretcher
- Pile the equipment up
- Move through the hallway
- Get down/up the stairs
- Out to the ambulance
- Into the ambulance
- Restage your equipment

And finally resume quality CPR!!

Treatment Recommendations

The AHA Classification Of Recommendations And Level Of Evidence

- **Class I** Conditions for which there is evidence and/or general agreement that a given procedure or treatment is useful and effective.
- **Class II** Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment.
- **IIa.** Weight of evidence/opinion is in favor of usefulness/efficacy
- **IIb.** Usefulness/efficacy is less well established by evidence/opinion
- **Class III** Conditions for which there is evidence and/or general agreement that the procedure/treatment is not useful/effective and in some cases may be harmful.
- **Class Indeterminate** Conditions for which there is Insufficient research, continuing area of research, or no recommendation until further research.

Return of Spontaneous Circulation

- Patient support continues
  - Intubated with ventilator support
  - Sedated for comfort
  - Pressors
  - Admission to Intensive Care Unit
  - Consider PCI therapy based on suspected etiology

ROSC

Initial Manual Cooling Algorithm

- Return of spontaneous circulation
- Initial temp > 34 degrees Celsius
- **ET in place**
- Confirm not responsive to verbal stimuli
- Expose patient. Perform 12-lead EKG
- Apply ice packs to groin and axilla
- Cold saline bolus: 30ml/kg, max 2L
- Versed 0.15 mg/kg slow IV push, max 10 mg (for sedation/shivering) with repeat B/P

Therapeutic Hypothermia

- American Heart Association
  - 2010 Updates
    - Therapeutic hypothermia in adult cardiac arrest patients shows improved neurological outcome for those that are discharged from the hospital

- Induced Therapeutic Hypothermia (ROSC)
  - Region VII ALS SMO's, Code 11
  - Key points
    - Cardiac arrest not related to trauma, hemorrhage, or infection
    - Age >18
    - Not currently pregnant
    - Patient is intubated and unresponsive
    - Initial temperature > 34 degrees C (93.2 F)

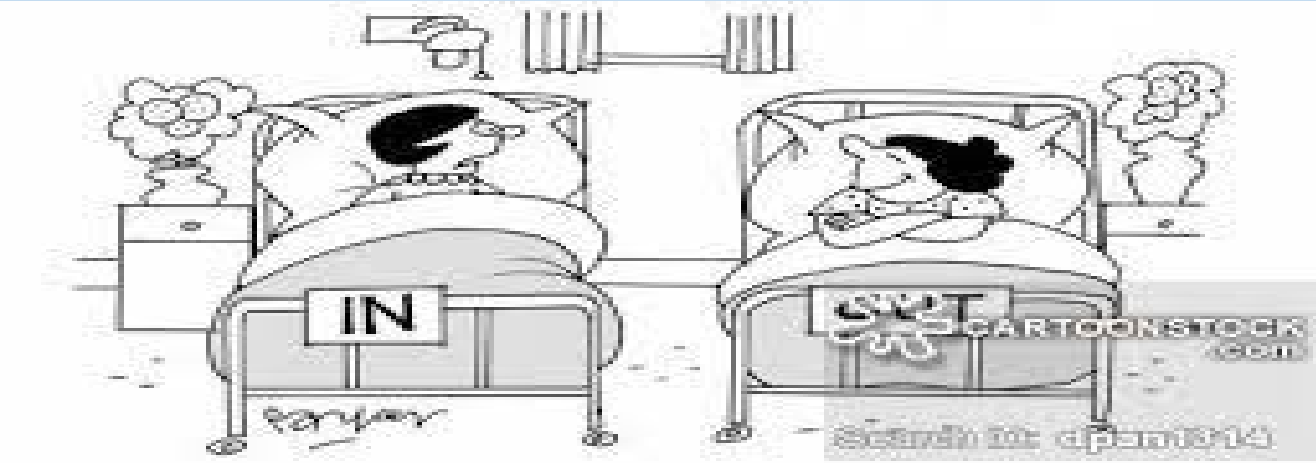
ROSC

- What current science says…
  - "A new study found that contrary to conventional belief, pre-hospital hypothermia had no effect on the rate of survival to hospital discharge or on neurological outcome among surviving cardiac arrest patients, either among patients with ventricular fibrillation (VF) or non-VF arrest."
  - "trial established….not simply that field cooling offered no advantage to patients. Instead, those patients randomized to prehospital cooling experienced re-arrest on the way to the hospital more often – 26 percent versus 21 percent – as well as increased pulmonary edema and use of diuretics."

Neurology Today: Volume 14(2), 16 January 2014, pp 1,9-9

Conclusion

- High quality post-resuscitative care is an important component of management of cardiac arrest with emphasis on treatment of reversible causes and metabolic conditions.
- Therapeutic hypothermia is effective in a select subset of cardiac arrest patients but is still being studied for its effectiveness
- Back to the basics…high quality CPR, early defibrillation and YOU are your patients best chance for survival and good outcomes



"It's alright for you-you're going home today!"