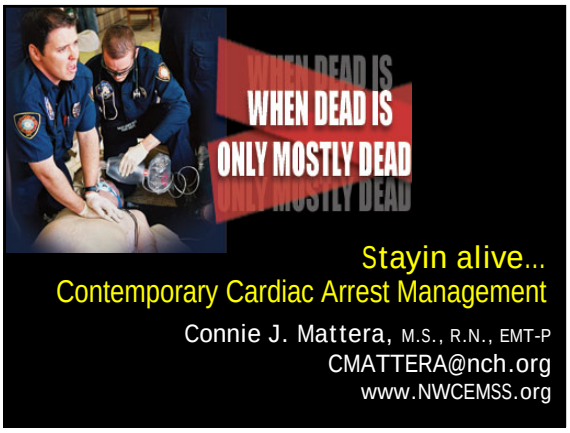


Stayin alive…
Contemporary Cardiac Arrest Management

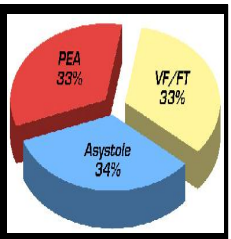
Connie J. Mattera, M.S., R.N., EMT-P
CMATTERA@nch.org
www.NWCEMSS.org

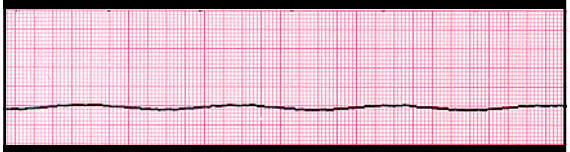
Upon completion the participant will

- identify priorities of care for pts in cardiac arrest.
- describe components of quality CPR.
- sequence management of cardiac arrest using a "pit crew" approach.
- discuss science supporting cardiac arrest mgt
- explain critical elements of *post-resuscitation care.*

- Major clinical syndrome of CAD
- 60% of deaths from CAD
- 1,000 deaths/day (250,000/yr in US)
- Sudden death definition: **Death within 1 hr of symptom onset** (VF)
- ⅔ of cardiac-related deaths unexpected
- 47% die prior to getting to a hospital

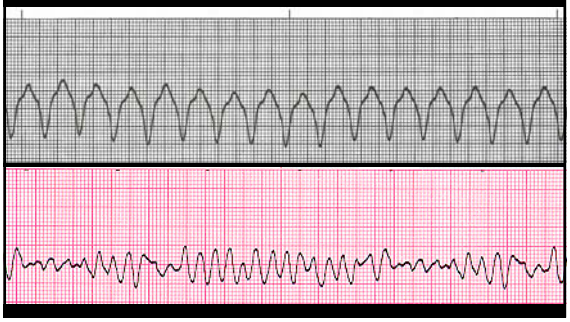
Dysrhythmias or conditions associated with cardiac arrest





Dysrhythmias or conditions associated with cardiac arrest

Dysrhythmias or conditions associated with cardiac arrest



Guidelines for care

Recommendations continue to evolve based on research

AHA guidelines - October 2010

Protocols should be based on evidence, not tradition or local bias

American Heart Association GUIDELINES CPR ECC 2010

DETAILS make a DIFFERENCE

Michael J. Kellum. Improving Performance of EMS Personnel during Resuscitation of cardiac arrest patients: the McMAID approach. Curr Opin Crit Care 15:216-220. 2009.

"A perfectly run code is a thing of beauty; but this "creature," although sometimes seen in captivity (on the carpets or tables in training centers), is unfortunately seldom seen in the wild. This is not good……"

Michael J. Kellum. Improving Performance of EMS Personnel during Resuscitation of cardiac arrest patients: the McMAID approach. Curr Opin Crit Care 15:216-220. 2009.

"…Failure to resuscitate a patient from a witnessed out-of-hospital cardiac arrest should not be accepted as an inevitable consequence of either the disease process or the complexity of the organized chaos we call resuscitation…."

Michael J. Kellum. Improving Performance of EMS Personnel during Resuscitation of cardiac arrest patients: the McMAID approach. Curr Opin Crit Care 15:216-220. 2009.

"…when the patient dies it is simply too easy to attribute failure to the disease, to elevated adrenaline levels of rescuers, or the fact that personnel experience only a few codes a year."

"Such rationalizations may protect us emotionally, but they foster clinical nihilism that in turn justifies a failure to improve performance."

Unless contraindicated, CPR should be started when pt is unresponsive and pulse canNOT be palpated

If DNR status unclear, start resuscitation D/C later if valid DNR is obtained

No CPR: Profound dependent lividity

Blue-purple coloring d/t blood pooling in dependent areas

Seen 30 min - 2 h after death; max 6-12 h

Body part in contact w/ firm surface shows impression as indentation surrounded by lividity (livor mortis)

No CPR: Rigor mortis

Stiffening after death - loss of ATP from muscles

Face & neck affected first (✓ jaw)

Begins ~2 h after death; 8-12 h completely stiff; lasts up to 18 h

Reverses & body returns to flaccid - gone after 36-48 hrs

Why change?

Highest survival for VF/PVT – critical elements are chest compressions & early defibrillation

In ABC sequence, compressions delayed to do A & B

< 50% of cardiac arrest victims get bystander CPR – find rescue breaths problematic?

Links are interdependent – System of Care

Immediate **recognition** of SCA & **activation** of emergency response system

Early, high quality BLS with emphasis on chest compressions

Rapid defibrillation

Effective ALS

Integrated post-cardiac arrest care

Code team roles

Depends on # of rescuers – focus on building team as additional persons arrive or delegate roles if multiple rescuers present

Code team roles

If a two-person response – one starts CPR and the other calls for help immediately from predetermined resources

If a Private, this may mean the local 9-1-1 EMS service

Major emphasis

All care organized around 2 minute cycles of CPR – many tasks can be performed concurrently rather than sequentially by integrated team

Look – Listen – Feel ***DELETED***

Inconsistent & time consuming

Tap victim on shoulder & shout, "Are you all right?" simultaneously with checking for absent or abnormal breathing (only gasps)

Treat pt with gasps as if they are apneic

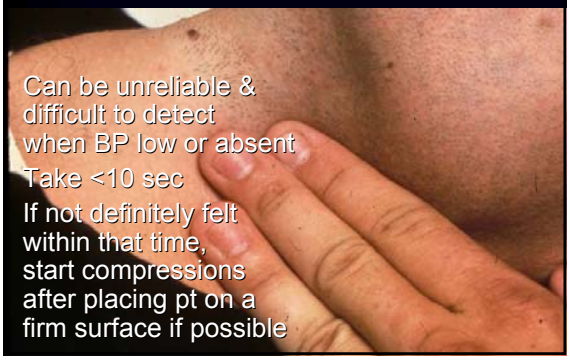
After years of debate regarding drugs, devices, and defib waveforms, what's most important?

If CPR is done poorly, it doesn't matter what ALS interventions are used

Science says…

Good ALS does NOT make up for poor BLS

De-emphasize pulse check



Can be unreliable & difficult to detect when BP low or absent

Take <10 sec

If not definitely felt within that time, start compressions after placing pt on a firm surface if possible

What does CPR actually do?

Blood flow depends on chest compressions

Quality CPR may

- prevent VF from deteriorating to asystole;
- ↑ chance of successful defibrillation;
- improve survival by providing circulation to heart and brain

What *is* QUALITY CPR?

Push HARD

Push FAST

RELEASE completely

Minimize interruptions (last compression to shock delivery)

Rotate compressor every 2 min

Continuous compressions once advanced airway placed

Unless monitor is equipped with CPR feedback software, cannot determine adequacy of compressions by looking at ECG

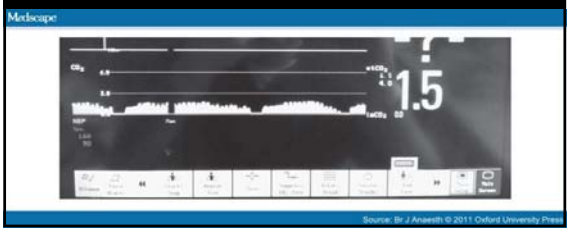
Can by looking at capnography…

What's the best noninvasive measure of CPR quality and CO during compressions?

Palpating a carotid/femoral pulse

$EtCO_2$ values (capnography)

If <10 X 20 min unlikely to survive



So what to do w/ ventilations?

Practice is changing!

No ventilation at all for several min

Passive oxygenation (OPA & NRM)

Continuous compressions w/o pausing for ventilations w/ BLS airways

Science says... Why can pts in cardiac arrest do OK without ventilations in early stages?

Positive pressure ventilation may not be necessary during the first few minutes of CPR because spontaneous agonal respirations often contribute to respiratory exchange of gases. Chest compression alone with a patent airway generates significant minute ventilation and the quantity of oxygen needed is reduced significantly during low blood flow states.[14,15] Chandra et al[15] assessed the time course of change in arterial blood gases during resuscitation in a canine experimental VF model and found that chest compression alone during CPR can maintain adequate gas exchange to sustain the oxygen saturation level above 90% for at least 4 minutes. Survival from out-of-hospital cardiac arrest is as good in humans when bystanders perform only chest compressions compared with when bystanders perform both chest compressions and mouth [illegible] lation.[17]

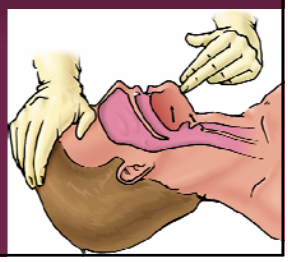
JAMA, 299:10:1188.

Airway & Ventilations

At this time, there is insufficient evidence to support the removal of ventilations from CPR provided by EMS professionals (AHA)

Open airway w/ manual maneuver

Head is heavy and will not easily stay where placed



What does AHA recommend in an adult?

Before advanced airway:
2 breaths during brief (3-4 s) pause after 30 compressions

30:2

Why 30:2?

Hemodynamic Parameter	15:2	15:2+ITD	30:2	30:2+ITD
SBP mmHg	53.3±5	68±5	54.6±5	62±4.5
DBP mmHg	19.6±1.2	21±2.4	26.4±1.3	29.7±1.6
Carotid Blood Flow (ml/min)	47.71±4.7	63.85± 4.9	81.71±5.3	111.74±7.1
Compressions/ min	66.13±2.4	65.2±2.1	83.89±1.6	85±1.2
No compression time (sec/min)	20.33±1.44	20.13±1.7	9.6±0.96	9.2±0.7

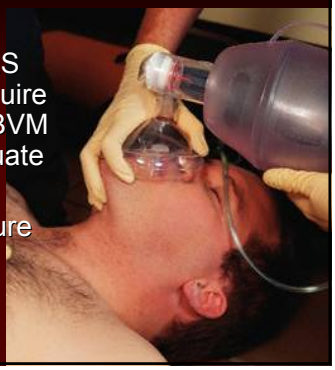
Yannopoulos et al Critical Care Medicine, 2006

Initial BLS airway

No advanced airway to start

Size & insert OPA &/or NPA for effective BVM ventilations

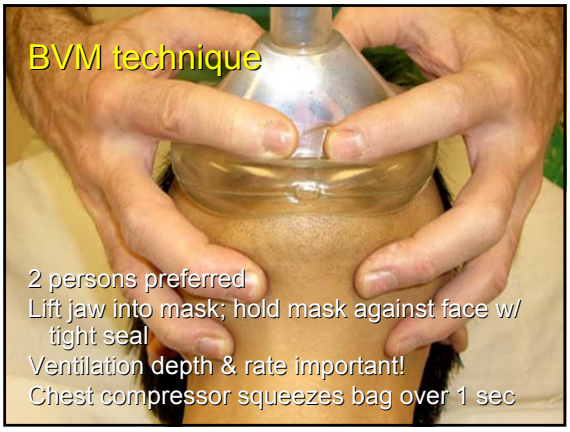
Initial ventilation challenges



- Failure to use BLS airways will require ↑ pressure on BVM to create adequate tidal volume
- Excessive pressure causes gastric distension

Why is gastric distension a problem?

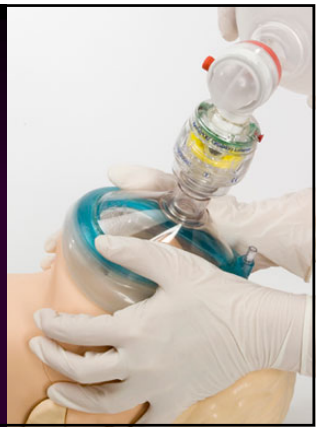
- Elevates diaphragm
- Cannot ventilate
- Predisposes patient to vomiting and aspiration



BVM technique

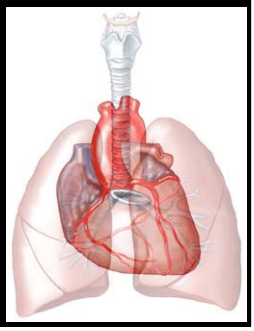
- 2 persons preferred
- Lift jaw into mask; hold mask against face w/ tight seal
- Ventilation depth & rate important!
- Chest compressor squeezes bag over 1 sec

What can be added to mask that improves effectiveness of chest compressions?



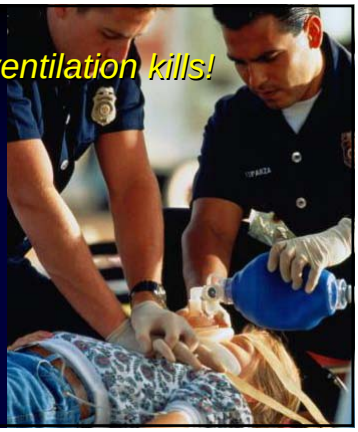
Goal: Deliver O_2, but don't overdo it!

Remember:
95% O_2 is 5 X more than RA (21%)
O_2 consumption is decreased during cardiac arrest



But, Hyperventilation kills!

Avoid ventilating too fast or too deeply
Every breath ↓ cardiac output



Hyperventilation-Induced Hypotension During Cardiopulmonary Resuscitation

Tom P. Aufderheide, MD; Gardar Sigurdsson, MD; Ronald G. Pirrallo, MD, MHSA; Demetris Yannopoulos, MD; Scott McKnite, BA; Chris von Briesen, BA, EMT; Christopher W. Sparks, EMT; Craig J. Conrad, RN; Terry A. Provo, BA, EMT-P; Keith G. Lurie, MD

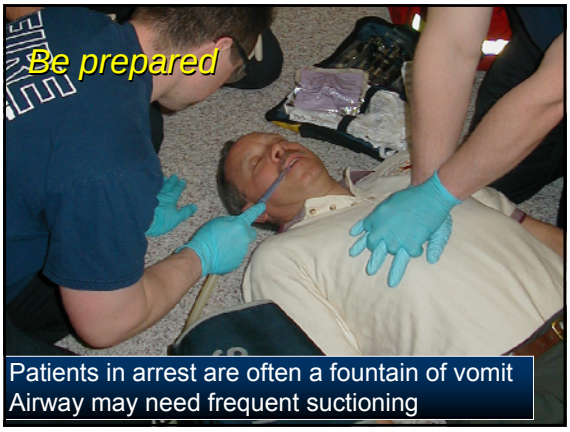
Background—A clinical observational study revealed that rescuers consistently hyperventilated patients during out-of-hospital cardiopulmonary resuscitation (CPR). The objective of this study was to quantify the degree of excessive ventilation in humans and determine if comparable excessive ventilation rates during CPR in animals significantly decrease coronary perfusion pressure and survival.

Methods and Results—In humans, ventilation rate and duration during CPR was electronically recorded by professional rescuers. In 13 consecutive adults (average age, 63±5.8 years) receiving CPR (7 men), average ventilation rate was 30±3.2 per minute (range, 15 to 49). Average duration per breath was 1.0±0.07 per second. No patient survived. Hemodynamics were studied in 9 pigs in cardiac arrest ventilated in random order with 12, 20, or 30 breaths per minute. Survival rates were then studied in 3 groups of 7 pigs in cardiac arrest that were ventilated at 12 breaths per minute (100% O_2), 30 breaths per minute (100% O_2), or 30 breaths per minute (5% CO_2/95% O_2). In animals treated with 12, 20, and 30 breaths per minute, the mean intrathoracic pressure (mm Hg/min) and coronary perfusion pressure (mm Hg) were 7.1±0.7, 11.6±0.7, 17.5±1.0 (P<0.0001), and 23.4±1.0, 19.5±1.8, and 16.9±1.8 (P=0.03), respectively. Survival rates were 6/7, 1/7, and 1/7 with 12, 20, and 30+ CO_2 breaths per minute, respectively (P=0.006).

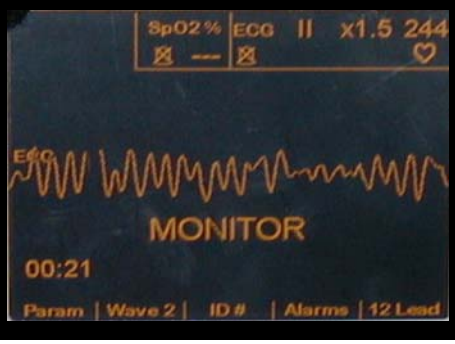
Conclusions—Professional rescuers were observed to excessively ventilate patients during out-of-hospital CPR. Subsequent animal studies demonstrated that similar excessive ventilation rates resulted in significantly increased intrathoracic pressure and markedly decreased coronary perfusion pressures and survival rates. (***Circulation*. 2004;109: 1960-1965.)**

Science says… hyperventilation kills!

port is that positive pressure ventilations during cardiac arrest may be harmful because they increase intrathoracic pressure, thereby decreasing venous return and subsequent myocardial and cerebral blood flow.[29] Probably due to the excitement and stress of resuscitation efforts, excessive ventilations by both physicians and EMS personnel are common.[29,30] Positive

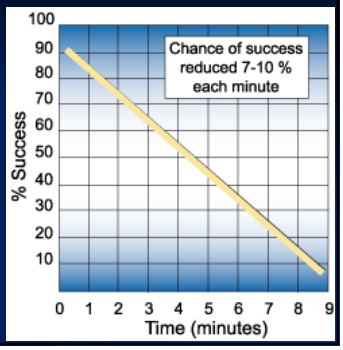


When should the 1st shock be provided?



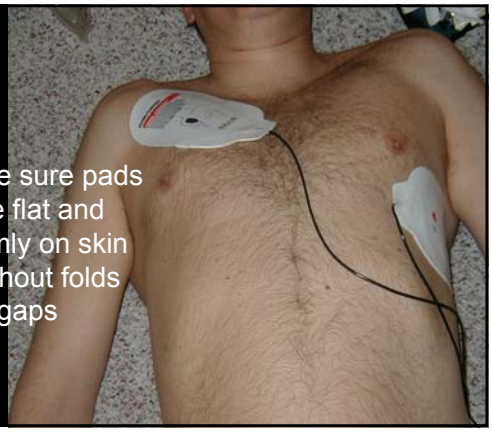
Time critical

Goal:
Interval from collapse to 1st shock **< 3 min** in 90% of arrests



Continue compressions while applying electrodes

Prep skin
Pad placement:
Anterior - R of sternum, under clavicle
Lateral - L of nipple in axilla

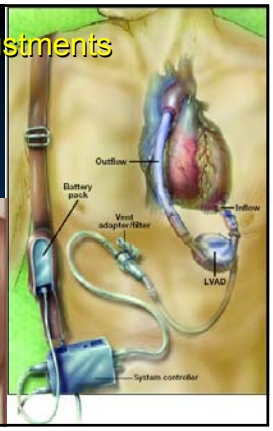


Make sure pads are flat and firmly on skin without folds or gaps

Anterior-posterior
Anterior-left infrascapular
Anterior- right infrascapular
All OK

Pad placement adjustments

Pts w/ implanted ICDs pacemakers, or VADs
Place electrodes 1" from device



How & when should rhythm be assessed?

Pause compressions no more than 5 sec to rotate compressor and ✓ ECG

If shockable rhythm…

Stop using, "I'm clear, you're clear, we're all clear."

Continue CPR while defibrillator is charging

Compressor announce CLEAR (end w/ compression)

Shock immediately

A second contributor to suboptimal survival of adults with out-of-hospital cardiac arrest is that defibrillation is typically provided after 5 or more minutes of VF cardiac arrest, the "circulatory" phase of VF arrest[25] when preshock and/or postshock myocardial perfusion are necessary for attaining return of spontaneous circulation.[26,27] Prolonged VF (the circulatory phase) is different from short-duration VF in regard to myocardial bioenergetics, cellular electrophysiology, whole-organ myocardial electrophysiology, and response to therapy.[13-15,18,19,22,28] Substantial, progressive depletion of myocardial high-energy phosphates occur during prolonged VF.[19,22] Moreover, characteristic changes occur in the VF waveform during prolonged VF from a coarse waveform initially to a fine waveform over time. As the duration of VF increases and the waveform becomes fine, defibrillation into a perfusing rhythm is less likely. Experimental and clinical studies indicate that preshock chest compressions for prolonged VF can prove the rate of successful resuscitation.[1,13-16,20,21] Furthermore, a recent clinical investigation demonstrated that even 10- to 20-second pauses in preshock compressions decrease defibrillation success.[23]

Science says…
Keep time between last compression & shock delivery to absolute minimum

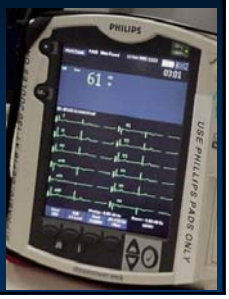
If organized rhythm NOT seen – immediately resume compressions (no pulse check)

When should the pulse be checked?

If organized rhythm on the monitor

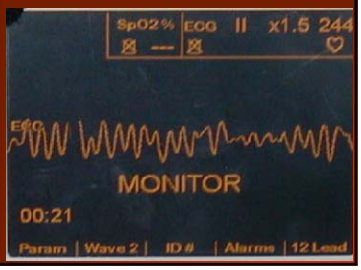
No pulse – resume CPR

Yes pulse – Check BP



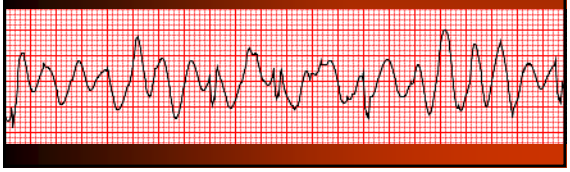
When should ECG be ✓ again?

After 2 minutes of CPR when compressors are rotated



Caveats for VF

- VF means heart is getting some blood
- Without coronary perfusion → asystole
- Resuscitate aggressively
- If prolonged VF, alter placement of pads, seek order to ↑ defib energy level



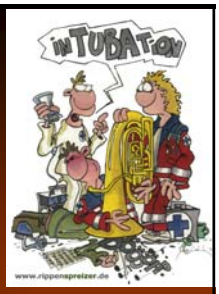
Should intubation or IV access be attempted before the first shock?

NO!

Why?

They will delay definitive treatment, which is CPR & defibrillation

Advanced airway



- Attempt to place w/o stopping compressions
- Consider deferring until patient fails to respond to initial CPR & defib or has ROSC (Class IIb)
- Optimize 1st attempt with suction, position, styletted tube, laryngeal pressure, lip retraction

ETI

- If unsuccessful, resume compressions, re-oxygenate
- Stop compressions < 10 sec - only if needed to visualize cords and insert tube
- Resume compressions immediately

ETI frequently associated with frequent / prolonged interruption of compressions

Better choice?

Science says…

Double improvement in long-term survival when rescue airway used first (Fales)

Possible explanations:

- Alternate airway placed quickly while CPR continues
- Once inserted, continuous compressions without pauses for ventilations are delivered

Ventilations after advanced airway

Do NOT pause compressions to ventilate

Do NOT attempt to synchronize compressions & ventilations

8-10/min

Breath q. 6 sec

Pulse ox?

NOT reliable in cardiac arrest

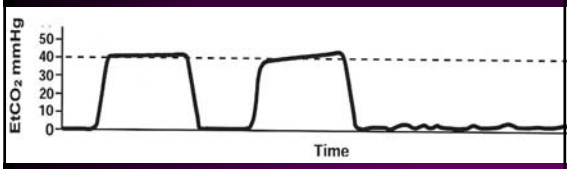
Blood flow inadequate in peripheral tissues

Assess oxygenation old fashioned way: color (lips, mucous membranes, tongue)

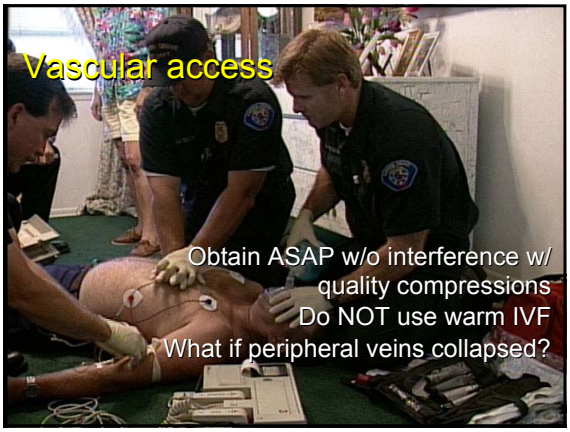
Don't use while pulseless

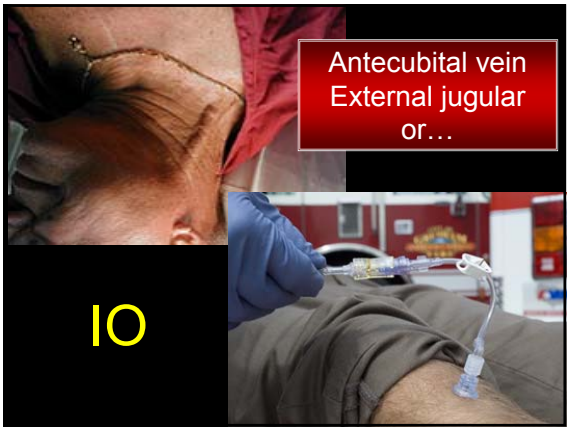
After moving an intubated patient in cardiac arrest from bed to floor the capnography alarm sounds

This waveform is seen:



What just happened?





Drug administration

ECC guidelines decrease emphasis on drugs - few supported by strong evidence

Priorities

- Good CPR
- Rapid defib
- Airway mgmt
- Then, vascular access and meds

Drug administration caveats

Given in their own time cycles separate from CPR/defib cycles

Drug Tsar should have drawn up & ready to go

Do NOT pause compressions to give drugs

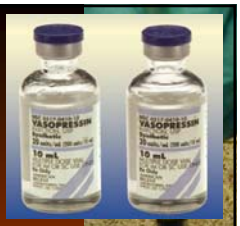
Properly performed CPR achieves a cardiac output that is approximately __% of normal.

33% for the first 10 minutes

1% after 10 minutes

What can be done to improve this?

Vasopressin dose



40 units IVP/IO (usually 2 vials)

One time only

Half life = 10-20 min

May be used to replace 1st or 2nd dose of epinephrine

Epinephrine cardiac arrest doses

Adults: 1:10,000 1 mg IVP/IO q. 3-5 min

Peds: IV/IO: 1:10,000 0.01 mg/kg

How can you document drug administration times accurately?

Or use event marker on ECG monitor

Antidysrhythmics

Amiodarone
or
Lidocaine
(not the preferred drug)

Amiodarone dose VF

Adult: 300 mg IVP/IO
Do not dilute
Rapid IVP/IO for VF

Should amiodarone be given ASAP after vasopressor or wait 3-5 min to see the effects of vasopressin or epi?

DON'T wait

Vasopressors & amiodarone are given for different reasons

Vasopressors improve CPR effectiveness

Amiodarone treats the dysrhythmia

At what dose may amiodarone be repeated for a patient in persistent VF?

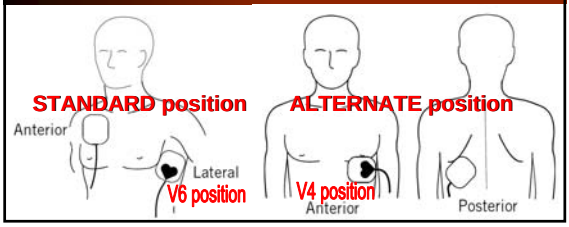
A. 50 mg
B. 100 mg
C. 150 mg
D. 300 mg

Persistent/Refractory VF

Apply new set defib pads in alternate position

Minimize compression interruption placing posterior pad

Defib using new pads in alternate position

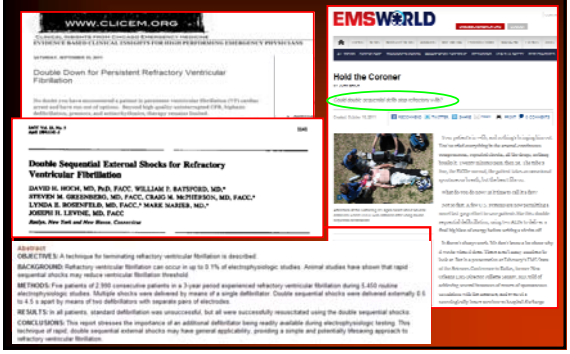


Persistent/Refractory VF

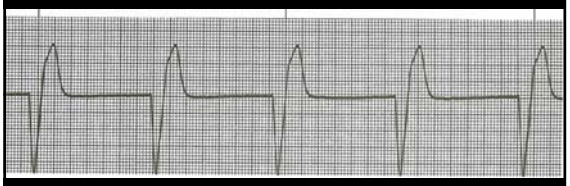
If Philips consider ↑ defib energy to **200 J**
NA – ZOLL biphasic: max = 200 J
NA – Physio LP12/15: max = 360 J

Persistent/Refractory VF

If 2nd defibrillator is available…



The patient remains pulseless and nonbreathing…



Consider Hs & Ts

- Hypovolemia (Most common treatable cause): IVF challenges
- Hypoxia: ✓ airway; O_2 delivery; gas exchange
- Hypothermia: Core rewarming w/ resuscitation
- Hypo/hyperkalemia (? renal failure/dialysis) – bicarb & albuterol
- Hydrogen ion (acidosis): (? DKA, renal failure/ dialysis, ASA OD) – consider need for bicarb

Consider Hs & Ts

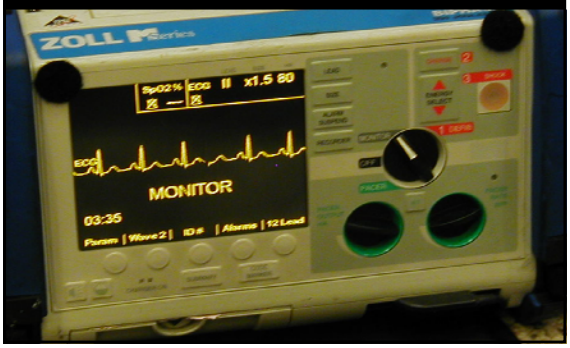
- Thrombosis (coronary): 12 L ECG ASAP after ROSC
- Thrombosis (pulmonary): IVF challenges
- Tamponade: IVF challenges
- Toxins: glucagon (beta blocker); bicarb (TCAs)
- Tension pneumothorax: ✓ lung sounds; pleural decompress

Asystole

Same priorities as VF except no defibrillation

Why is atropine out?

Return of spontaneous circulation



How likely is it that someone will survive a cardiac arrest?

VF: 2%-50% depending on the study
If VF converts to a rhythm w/ a pulse > 100, survival is > 40%
Factors associated w/ survival
- Time to defibrillation
- Effectiveness of CPR
- Skill & knowledge of code commander
- Timeliness of medication administration

What's your first clue that the patient has experienced ROSC?

Capnography readings often suddenly rise - ~30 seconds prior to pulse detection

ROSC Objectives

Control body temp to optimize survival & neurological recovery
Identify and treat ACS
Optimize mechanical ventilation to minimize lung injury
Reduce risk of multiorgan injury and support organ function

ROSC: Post-resuscitation Care

Ensure adequate airway & support breathing
Elevate head 30° if tolerated to ↓ ICP, aspiration & pneumonia
Monitor closely capnography, pulse ox, VS
Titrate O_2 to maintain SpO_2 94% w/o oxygen toxicity

Post ROSC Care

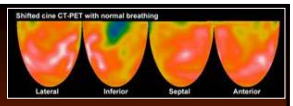
Do NOT hyperventilate even if ↑ $ETCO_2$
Support BP/MAP maintain heart & brain perfusion
Acquire 12L
Initiate TH

Note to self…

Patients have to overcome "opening pressure" of ResQPod's resistance system (~ -10 cm H_2O) before air can enter device

Remove as soon as CPR stopped

Post-ROSC



Pathophysiology

- Stunned myocardium
- Epinephrine wears off
  Coronary perfusion pressure decreases
- If tx does not affect overall mortality rate

EMS implication

- Monitor VERY CLOSELY first 10 min
- Keep finger on pulse (assign someone to detect weakening/loss of pulse
  Have dopamine ready – before need it

Post ROSC Care

BP support HIGHER priority than TH

If hypotensive, begin DOPAMINE – FIRST

After dopamine started, then start line for IVF

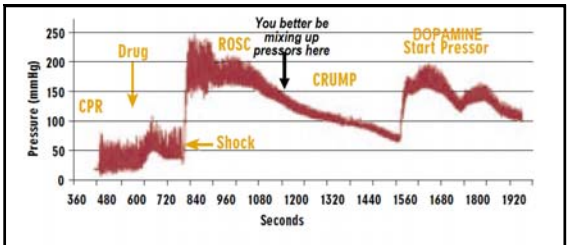


Figure 5: Medications given during resuscitation wear off shortly after the return of spontaneous circulation. In this graph of mean arterial pressure, an experimental animal resuscitated from cardiac arrest shows a high pressure initially after a rescue shock produces ROSC. However, this initial hypertension rapidly dissipates. This rapid decline is known as the "CRUMP" and will cause the patient to lose pulses again if not anticipated and countered with an infusion of some vasopressor. Note the increase in pressure produced by chest compressions (CPR) after administration of a drug. (Menegazzi, 2008.)

Post ROSC Care

Q: How do I give dopamine via IO line?

Turn OFF main IV on pressure bag using roller clamp

- Connect dopamine to proximal IV port
- Regulate dopamine w/ roller clamp
- Due to lower rate of infusion (mcgtts) dopamine should flow w/o pressure bag

Won't flow at mcgtt rate needed for dopamine?

- Flush IO with 20 mL NS or
- Begin peripheral IV line for dopamine

Re-Arrest

Incidence:
Occurs in 38%

Time to re-arrest
Ave 2-6 min

Most common type
PEA

Thus, watching ECG will not detect

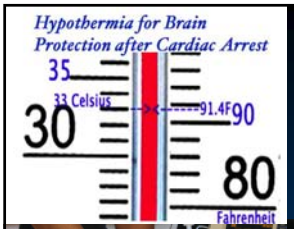
Need to be palpating pulse


ORIGINAL CONTRIBUTIONS

INCIDENCE OF REARREST AFTER RETURN OF SPONTANEOUS CIRCULATION IN OUT-OF-HOSPITAL CARDIAC ARREST

Therapeutic Hypothermia (TH)

Indications: Cardiac Arrest w/ ROSC



Consider therapeutic hypothermia (32°C-34°C) for any pt unable to follow verbal commands after ROSC

Therapeutic Hypothermia (TH)

Contraindications

Awake/follows commands

Bleeding (known bleeding or bleeding disorder)

Pregnancy – known/suspected

Surgery (major head, chest, abd) within 14 days

Temperature less than 34° C / 93.2° F

Traumatic arrest

Caution: Pediatric – contact OLMC prior

Therapeutic Hypothermia (TH)

Equipment needed

- Maintain minimum of 2 liters cold NS
- In minimum of one cooler set @ 4° C / 39° F

Practice (r)evolution: Field Rx vs. rapid transport

Work through entire protocol and provide good CPR for at least 30 min on scene or longer before moving pt

Why should EMS not move most pts during CPR?

Quality compressions critical to good outcomes

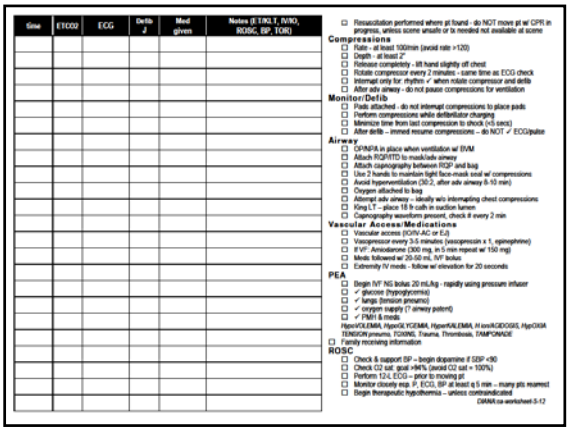
Studies demonstrate quality compressions are NOT performed when pt is being moved

Do NOT transport w/ CPR in progress unless pt needs Tx NOT available on scene (trauma) or scene unsafe

Practice - Practice - Practice

Requires excellent preparation and careful attention to procedure sequencing and performance to skillfully manage a cardiac arrest

Don't practice until you get it right, practice until you can't get it wrong.



If monitored asystole persists

Consider quality of resuscitation

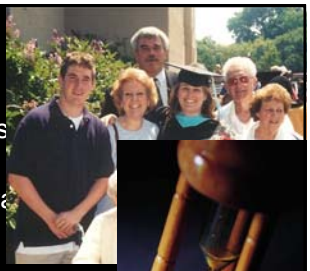
Are any atypical clinical features present?

After 30 minutes of resuscitation, seek an order to cease resuscitation

AHA Guidelines

"Stated succinctly, if ACLS care in the field cannot resuscitate the victim, ED care will not resuscitate the victim…Cessation of efforts in the out of hospital setting, following system-specific criteria and under direct medical control, should be standard practice in all EMS systems."

Time passes.
Life happens.
Distance separates
Children grow up.
Love waxes and wa
Hearts break.
Loved ones die.
Colleagues forget favors.
Careers end.



But…

Special people are there no matter how much time and how many miles are between you.

When you have to walk a lonesome valley, they will be on the valley's rim, cheering you on, praying for you, pulling for you, waiting with open arms at the valley's end.