NORTHWEST COMMUNITY EMERGENCY MEDICAL SERVICES SYSTEM

EST 1972

Cardiac Arrest & Therapeutic Hypothermia

Continuing Education May 2012

Questions/comments on this CE are welcome and should be directed to:
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Cardiac Arrest & Therapeutic Hypothermia – Diana Neubecker RN BSN PM

Objectives

In-class

1. Explain **pt monitoring** during cardiac arrest.
2. Analyze management of ***PEA***.
3. Discuss management of ***persistent/refractory VF***.
4. Describe critical elements of ***post-resuscitation care***.
5. Explain the use of ***therapeutic hypothermia***.
6. Demonstrate high quality ***pit-crew approach to team resuscitation*** utilizing the NWC EMSS SOP's.

Independent Study - See content materials

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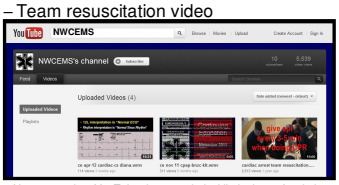
Objectives

Independent Study

- See YouTube site: "NWCEMS" for
  - Additional CE powerpoint content
  - Team resuscitation video



Note: posted on YouTube due to technical limitations of website

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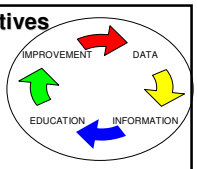
Objectives

In-class time - focus on:



1. Areas for improvement noted on QI ePCR review
2. Practice team resuscitation skill rarely used
3. What's new – therapeutic hypothermia

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Pt Monitoring during CPR

1. What should be assessed every 2 min during CPR?
   - **A. ECG rhythm**
   - **B. ETCO2 value**
2. Why?
   - **A. ECG - determine need defib or ✓ pulse**
   - **B. ETCO2 - determine CPR effectiveness**
3. When should pulse be checked?
   - **Only when organized ECG rhythm seen**

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Pt Monitoring during CPR

Capnography

- **Measures CPR effectiveness**
  - **Non-invasive measurement of perfusion**
- **Signal ROSC**

  - **Sudden, dramatic rise ~30 sec before pulse**
- **Predict potential for survival**
  - **<10 mmHg x 20 min unlikely to survive**

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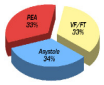
Pulseless Electrical Activity (PEA)

- **Clinical findings**



  - **ECG rhythm (+) present**
  - **Pulse (-) absent**
- **Incidence increasing (incidence of VF ↓)**
  - **Possibly due to CV meds pts are taking**
  - **Estimated 22-60% of arrests**
- **Types**
  - **True PEA: myocardial contraction (-) absent**
  - **Pseudo PEA: myocardial contraction (+) present**
    - **Detected with ultrasound**

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PEA – Look for Causes

- **HypoVOLEMIA**
  - **IVF bolus**
- **HypOXIA**
  - **✓ O2 supply**
- **HypoGLYCEMIA**
  - **✓ glucose**
- **Hydrogen ion** (acidosis)
  - **✓ PMH renal failure**
- **Hypo/hyperKALEMIA**
  - **✓ PMH renal failure**
- **HypoTHERMIA**
  - **✓ temp**
- **Tension pneumothorax**
  - **✓ lung sounds**
- **Toxins**
  - **✓ meds**
- **Tamponade**
  - **IVF bolus**
- **Thrombosis (coronary/pulmonary)**
  - **IVF bolus**
- **Trauma**

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PEA

Assessment & Treatment – Check:

1. **IV infusing rapidly**
2. **Glucose**
3. **Lungs**
4. **O_2 supply**
5. **PMH & meds**

PEA

IGLOP

This "list" is the "H&T's" - critical to remember!

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PEA

Treatment – begin 1st

- **IVF bolus**
  - **20 mL/kg**
  - **As fast as possible**
  - **Use pressure infuser**
  - **Start 2nd line**

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PEA

- PEA is a condition – NOT an ECG rhythm
- Document
  - "0" in pulse section
  - Rhythm in "ECG monitor" section
  - ECG/heart rate in comments

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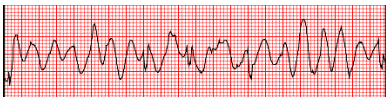
Ventricular Fibrillation (VF)

- VF indicates the heart muscle is receiving blood
- Without coronary perfusion, asystole will develop
- Thus, pts in VF should be aggressively resuscitated



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Persistent/Refractory VF

- VF that continues despite usual tx per SOP
  - NOT VF that recurs post successful defib
  - Cases have occurred in-system lasting >30 minutes
- Defibrillation: stun myocardium, stop electrical activity, to allow pacemaker to initiate organized rhythm
- Tx
  - EMS: Apply new set defib pads in alternate position
  - OLMC consider:
    - Increase to max defib energy (Zoll 360j, Philips 200j)
    - Additional antiarrhythmic (e.g., lidocaine)
    - Double/dual sequential defibrillation

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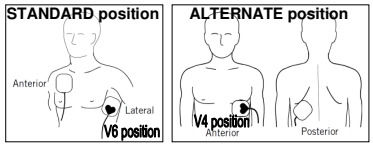
Persistent/Refractory VF

- Apply fresh/new set defib pads in alternate position
  - Minimize compression interruption placing posterior pad
- Defib using -new pads- in alternate position



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Persistent/Refractory VF

OLMC: consider increasing defib energy

- ZOLL (120-150-200 j): increase to 360 j
- Philips (150 j): increase to 200 j
- NA - Physio: defibs @ max 360 j

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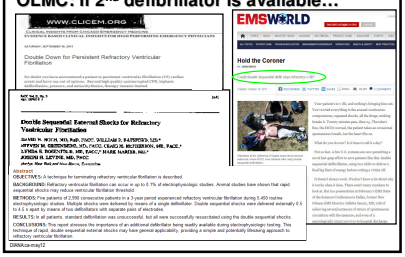
Persistent/Refractory VF

OLMC: If 2nd defibrillator is available…



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Re-Arrest

- Incidence
  - Occurs in 38%
- Time to re-arrest
  - Average 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

David D. Salcido, MPH, Amanda M. Stephenson, MD, Joseph P. Costello, MS, Clifton W. Callaway, MD, PhD, James J. Menegazzi, PhD

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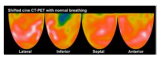
Re-Arrest

- 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



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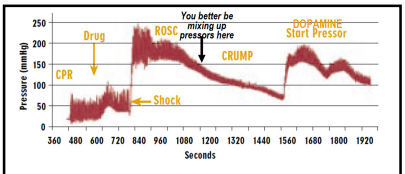

Figure 5: Medications given during resuscitation wear off shortly after the return of spontaneous circulation. In this graph of mean arterial pressure, an experimental animal resuscitated from cardiac arrest shows a high pressure initially after a rescue shock produces ROSC. However, this initial hypertension 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.)

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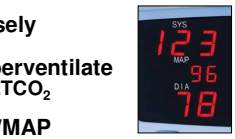
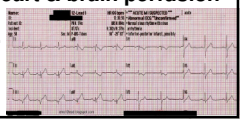
Post ROSC Care

1. **Monitor closely**
2. **Do NOT hyperventilate**
   - **even if ↑ $ETCO_2$**
3. **Support BP/MAP**
   - **maintain heart & brain perfusion**
4. **Acquire 12L**
5. **Initiate TH**





Post ROSC Care

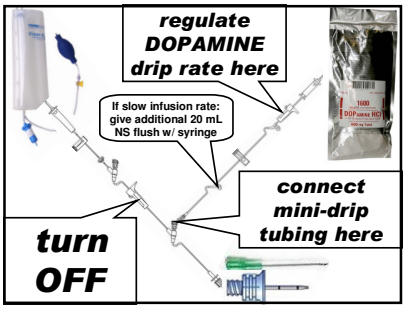
BP support is HIGHER priority than therapeutic hypothermia

- **If hypotensive, begin DOPAMINE – FIRST**
- After dopamine started, then start 2nd line for cold IVF

Post ROSC Care

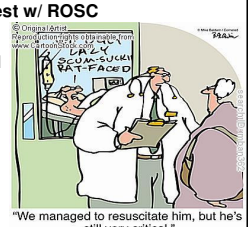
FAQ: How do I give dopamine via IO line?

1. **Turn OFF main IV (on pressure bag) using roller clamp**
2. **Connect dopamine to proximal IV port**
3. **Regulate dopamine w/ roller clamp**
4. **Due to lower rate of infusion (mcgtts) dopamine will almost always flow without use of pressure bag**
   - **A. If will not flow at rate needed for dopamine**
     - **i. Flush – using syringe – IO w/ 20mL NS or**
     - **ii. Begin peripheral IV line for dopamine**



Therapeutic Hypothermia (TH)

- **Indications**
  - **Cardiac Arrest w/ ROSC**
- Contraindications
- Equipment needed
- Procedure
- Documentation



"We managed to resuscitate him, but he's still very critical."

Therapeutic Hypothermia (TH)

- Indications
- **Contraindications**
  1. **Awake/follows commands**
  2. **Bleeding (known bleeding or bleeding disorder)**
  3. **Pregnancy – known/suspected**
  4. **Surgery (major head, chest, abd) within 14 days**
  5. **Temperature less than 34º C / 93.2º F**
  6. **Traumatic arrest**
  7. **Caution: Pediatric – contact OLMC prior**
- Equipment needed
- Procedure
- Documentation

Therapeutic Hypothermia (TH)

- Indications
- Contraindications
- **Equipment needed**
  - **Maintain minimum of 2 liters cold NS**
  - **In minimum of one cooler set @ 4º C / 39º F**
- Procedure
- Documentation

Therapeutic Hypothermia (TH)

- Indications
- Contraindications
- Equipment needed
- **Procedure**
  1. **✓ P, ECG rhythm, BP, O_2 sat, $ETCO_2$, 12L, Temp**
     - **A. If hypotension: begin Dopamine**
     - ***TREATING HYPOTENSION - HIGHER PRIORITY THAN TH***
     - **B. Establish 2nd vascular access for cold NS**
  2. **Place/confirm adv airway (ET/KLT)**
     - **Avoid hyperventilation, even if ↑ $ETCO_2$**
- Documentation

Therapeutic Hypothermia (TH)

- Indications
- Contraindications
- Equipment needed
- **Procedure (continued)**
  3. **Place cold packs on neck, axilla, groin**
     - **6 cold packs**
     - **Remove clothing; provide privacy w/ sheet**
- Documentation

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Therapeutic Hypothermia (TH)

- Indications
- Contraindications
- Equipment needed
- **Procedure (continued)**
  - **4. Administer cold NS 30 mL/kg (max 2 L)**
    - **A. Amount**
      - **Greater than 50 kg (110 lbs) = 2000 mL**
      - **35 – 50 kg = 1500 mL**
      - **Less than 35 kg: calculate based on 30 mL/kg**
    - **B. As fast as possible (less than 30 min)**
      - **Use pressure infuser maintained @ 300 mmHg**
    - **C. While enroute to hospital**
- Documentation

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Therapeutic Hypothermia (TH)

- Indications
- Contraindications
- Equipment needed
- **Procedure (continued)**
  - **5. If shivering & SBP >90**
    - **A. Administer midazolam 2 mg**
      - **Every 5 min to max 20 mg PRN**
    - **B. Shivering often first seen - jaw/mandible**
  - **6. Upon ED arrival: notify ED RN/MD**
    - **Therapeutic hypothermia initiated**
- Documentation

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Therapeutic Hypothermia (TH)

- Indications
- Contraindications
- Equipment needed
- Procedure
- **Documentation**
  1. **After ROSC – assess every 5 min: ECG, P, BP, O_2 sat, $ETCO_2$**
  2. **Glucose level, 12L ECG**
  3. **"Procedures"**
     - **A. "Temp measurement" = method used & reading**
       - **before TH, repeat upon ED arrival**
     - **B. "Cold pack" – "comments" = "neck, axilla, groin"**
     - **C. "Cardiac – Post-Resuscitation Cooling"**
  4. **Medication administered" = "Normal Saline (0.9%)"**
     - **"Dosage" = total amt infused in mL - upon ED arrival**
     - **"Comments" = "COLD"**

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Pit-Crew (5 person)

1. **Compressions - begins**
2. **Monitor**
   - A. Turns on
   - B. Attach defib pads
   - C. Will take over compressions
3. **Airway**
   - A. Insert OP/NPA
   - B. Connect BVM to RQP/ITD & capnography
   - C. After adv airway placed rotate into compressions
4. **Vascular access – PM**
   - A. Establish IV/IO
   - B. Give meds
5. **Team leader – PM**

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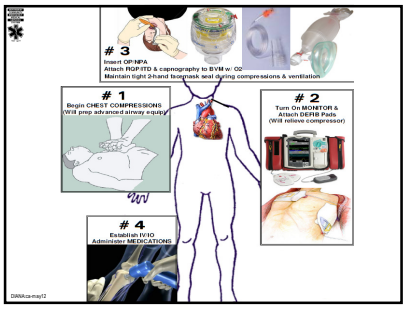

time	ETCO2	ECG	Defib J	Med given	Notes (ET/KLT, IV/IO, ROSC, BP, TOR)

☐ Resuscitation performed where pt found - do NOT move pt w/ CPR in progress, unless scene unsafe or tx needed not available at scene

Continuous Compressions

- ☐ Rate - at least 100/min
- ☐ Depth - at least 2”
- ☐ Release completely - lift hand slightly off chest
- ☐ Rotate compressor every 2 minutes - same time as ECG check
- ☐ Interrupt only for: (1) rhythm ✓ when rotate compressor and (2) defib
- ☐ After adv airway - do not pause compressions for ventilation

Monitor/Defib

- ☐ Pads attached - do not interrupt compressions to place pads
- ☐ Perform compressions while defibrillator charging
- ☐ Minimize time from last compression to shock (<5 secs)
- ☐ After defib – immed resume compressions – do NOT ✓ ECG/pulse

Airway

- ☐ OP/NPA in place when ventilation w/ BVM
- ☐ Attach RQP/ITD to mask/adv airway
- ☐ Attach capnography between RQP and bag
- ☐ Use 2 hands to maintain tight face-mask seal w/ compressions
- ☐ Avoid hyperventilation (30:2, post adv airway 8-10 min)
- ☐ Oxygen attached to bag
- ☐ Attempt adv airway – ideally w/o interrupting chest compressions
- ☐ King LT – place 18 fr cath in suction lumen
- ☐ Capnography waveform present, check # every 2 min

Vascular Access/Medications

- ☐ Vascular access (IO/IV-AC or EJ)
- ☐ Vasopressor every 3-5 minutes (vasopressin x 1, epinephrine)
- ☐ If VF: Amiodarone (300 mg, in 5 min repeat w/ 150 mg)
- ☐ Meds followed w/ 20-50 mL IVF bolus
- ☐ Extremity IV meds - follow w/ elevation for 20 seconds

If PEA – consider

- ☐ ***HypoVOLEMIA (most common tx cause) – give IV NS 20 mL/kg w/ pr infuser
- ☐ HypoGLYCEMIA – check glucose level
- ☐ HypOXIA – check airway & oxygen
- ☐ H ion excess/ACIDOSIS (? DKA, renal failure/dialysis, ASA OD) – sodium bicarb
- ☐ HyperKALEMIA (? renal failure/dialysis) – bicarb & albuterol
- ☐ TENSION pneumo – recheck lung sounds, pleural decompression
- ☐ TOXINS – naloxone (opoids), glucagon (beta blocker), bicarb (cyclic antidepr)
- ☐ TAMPONADE – IVF bolus
- ☐ Trauma – hypovolemia, hypoxia, tension pneumo, tamponade

☐ Family receiving information

ROSC

- ☐ ***Check & support BP – begin IVF/dopamine if SBP <90
- ☐ Check O2 sat: goal 94 - 99%
- ☐ Perform 12-L ECG – prior to moving pt
- ☐ ***Monitor pt closely esp. HR, ECG, BP at least q 5 min – many pts rearrest
- ☐ Begin therapeutic hypothermia - if indicated

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Procedure:

Therapeutic Hypothermia (TH) after Cardiac Arrest

Indication	Cardiac Arrest
Contra-indications	• 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 to initiating therapeutic hypothermia
Equipment	Maintain minimum of 2 liters NS in (minimum of one) cooler set @ 4° C / 39° F
Procedural Steps	**1. After ROSC** a. Assess P, ECG rhythm, BP, O_2 sat, $ETCO_2$, 12L, and temperature • If hypotension: begin Dopamine – **Treating hypotension higher priority than therapeutic hypothermia** – Establish 2nd vascular access site (IO/IV) for cold NS – Goal MAP = 90-100 **2. Place/confirm advanced airway (ET/KLT). Avoid hyperventilation**; even if ↑ ETCO2. **3. Place cold packs on neck, axilla, groin** (6 cold packs) a. Remove clothing; provide privacy w/ sheet. **4. Administer cold NS 30 mL/kg (max 2 L) - as rapidly as possible (less than 30 min),** use pressure infuser maintained @ 300 mm Hg, while enroute to hospital. a. Greater than 50 kg (110 lbs) = 2000 mL b. 35 - 50 kg = 1500 mL c. Less than 35 kg: calculate based on 30 mL/kg **5. If shivering & SBP >90**: administer midazolam 2 mg every 5 minutes to max 20 mg. a. Shivering often first seen in jaw/mandible **6. Upon ED arrival: Notify ED RN/MD therapeutic hypothermia has been initiated.** **7. Document on ePCR** a. After ROSC – assess every 5 minutes (1) ECG rhythm (2) Pulse (3) BP (4) O_2 sat (5) $ETCO_2$ b. Glucose level c. 12L ECG results d. "Procedures" (1) "Temperature measurement" = method used & reading - before cold IVF (2) "Temperature measurement" = method used & reading - upon ED arrival (3) "Cold pack" – "comments" = "neck, axilla, groin" (4) "Cardiac – Post-Resuscitation Cooling" e. "Medication administered" = "Normal Saline (0.9%)" (1) "Dosage" = total amt in mL infused - upon ED arrival (2) "Comments" = "COLD"

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Procedure:

Therapeutic Hypothermia (TH) after Cardiac Arrest

YES	NO	Checklist
☐		Cardiac Arrest – ROSC
	☐	NO: Awake/follows commands
	☐	NO: Bleeding (known active bleeding or bleeding disorder)
	☐	NO: Pregnancy (known/suspected)
	☐	NO: Surgery (major head, chest, abd) within 14 days
	☐	NO: Temperature less than 34° C / 93.2° F
	☐	NO: Traumatic arrest
☐		Adult (if Pediatric – contact OLMC)
☐		Place/confirm ET/KLT w/ capnography; avoid hyperventilation (even if ETCO2 ↑)
☐		Assess BP: **If hypotension - begin dopamine first;** establish 2nd IV/IO for cold IVF
☐		Obtain 12-L ECG
☐		Record baseline temperature (repeat @ ED arrival – using same device/method)
☐		Apply cold packs to neck, axilla, groin (remove pts clothing; cover w/ sheet)
☐		**Administer cold NS 30 mL/kg (max 2L) as rapidly as possible** (less than 30 min) use pressure infuser @ 300 mm Hg, while enroute to hospital • Greater than 50 kg (110 lbs) = 2000 mL • 35 - 50 kg (110 lbs) = 1500 mL • Less than 35 kg: calculate based on 30 mL/kg
☐		If shivering & SBP >90: administer midazolam 2 mg, every 5 min, to max 20 mg
☐		Via OLMC and upon ED arrival - notify ED RN/MD hypothermia has been initiated
☐		Assess & document on ePCR: (1) After ROSC – assess every 5 minutes: ECG, P, BP, O_2 sat, $ETCO_2$ (2) Glucose level (3) 12L ECG (4) "Procedures" a. "Temp measurement" = method used & reading - before TH & upon ED arrival b. "Cold pack" – "comments" = "neck, axilla, groin" c. "Cardiac – Post-Resuscitation Cooling" (5) "Medication administered" = "Normal Saline (0.9%)" a. "Dosage" = total amt infused, upon ED arrival, in mL b. "Comments" = "COLD"

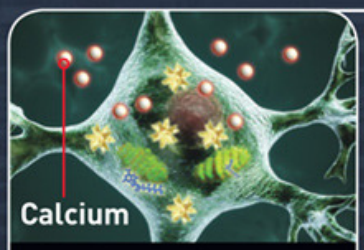
Co	=	Fo
40	=	104
39	=	102.2
38	=	100.4
37	***=***	***98.6***
36	=	96.8
35	=	95
34	**=**	**93.2**
33	**=**	**91.4**
32	**=**	**89.6**

HOW A COLD HEART CAN SAVE YOUR BRAIN

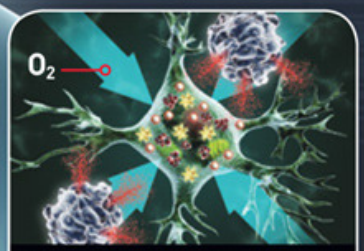
In therapeutic hypothermia, doctors intentionally cool cardiac-arrest patients to 91°. The idea is to slow the cellular reactions that can cause brain and other organ damage after the heart restarts. The physician Lance Becker found that giving oxygen to cells that had been starved while the heart was stopped causes the cell to produce too many free radicals, which sends it into suicide mode.

Usually, cells consume oxygen and glucose to produce the energy molecule ATP. Below, what happens to a cell when cardiac arrest cuts off the oxygen and the body is resuscitated, either normally or cooled.

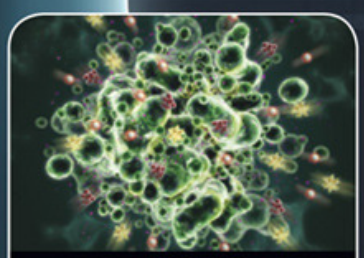
WARM



When the cell's ion pumps shut down, the cell immediately begins hoarding excess calcium ions and dangerous free radicals.

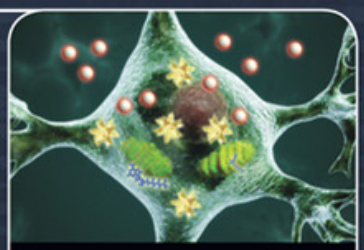


For reasons poorly understood, body-temperature cells with disrupted ion levels provoke the immune system to attack the cell.



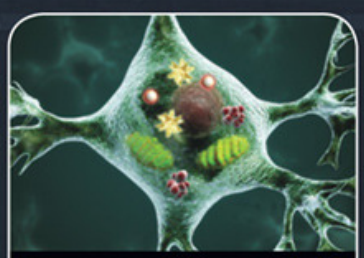
Mechanisms inside the cell kick-start various processes that cause it to rip itself apart, essentially committing suicide.

COOLED



If doctors cool the patient after cardiac arrest, the cell's free-radical and calcium levels remain relatively low.

With normal ion levels, the cell does not alert the immune system to any major problems when the oxygen returns.



The chilled cell is able to withstand the shock of restarting cellular metabolism, and it eventually recovers function.