UC Neuroscience Institute AT UNIVERSITY HOSPITAL

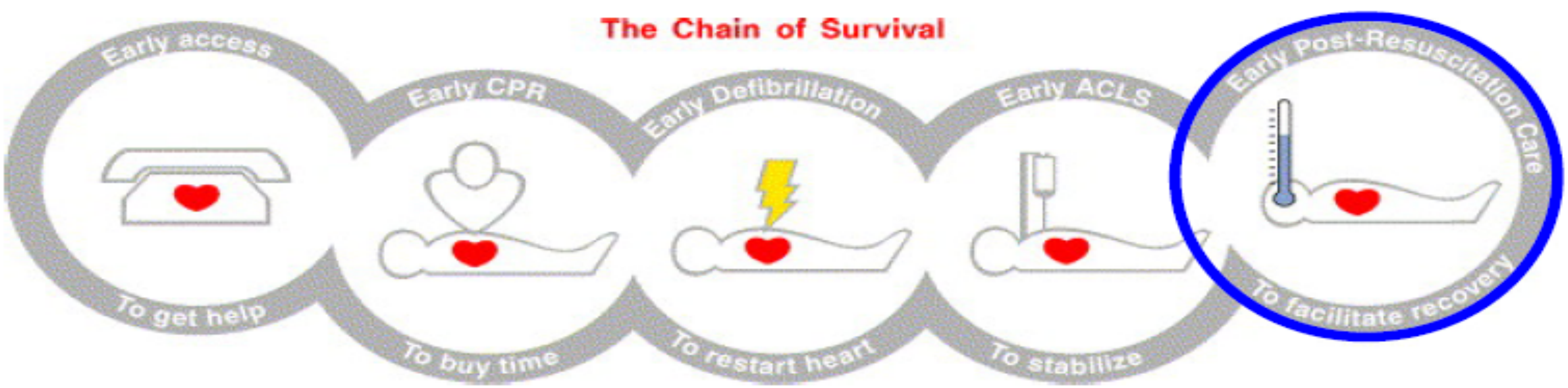
NEUROCRITICAL CARE

UNIVERSITY OF Cincinnati

Hypothermia for Cardiac Arrest

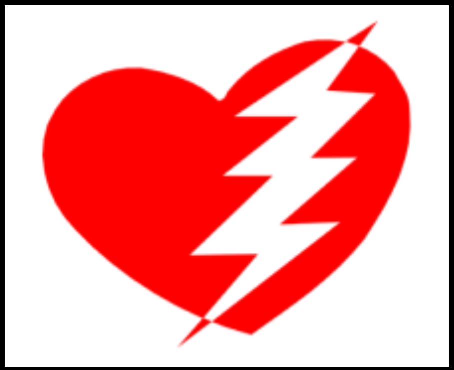
William A. Knight IV, MD
Department of Emergency Medicine
Department of Neurosurgery
Division of Neurocritical Care
University of Cincinnati

Ohio Chapter of the American College of Cardiology
20th Annual Meeting
October 16, 2010



Case Presentation

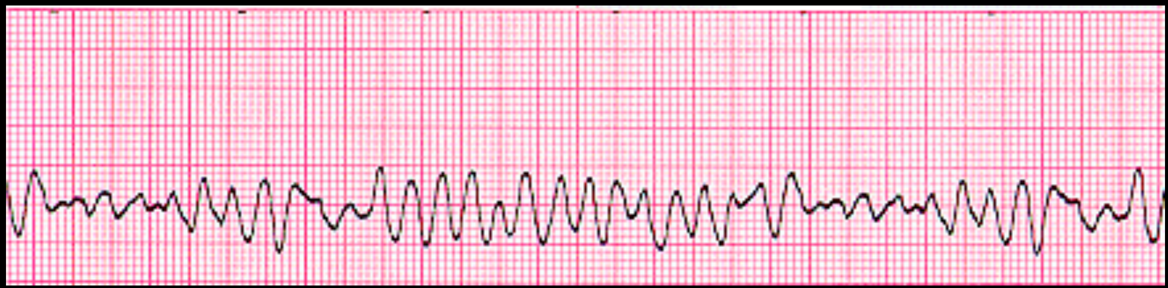
- 78 year old man collapses at the mall
- EMS activated



- No bystander CPR
- No AED
- EMS arrives 8 minutes after collapse

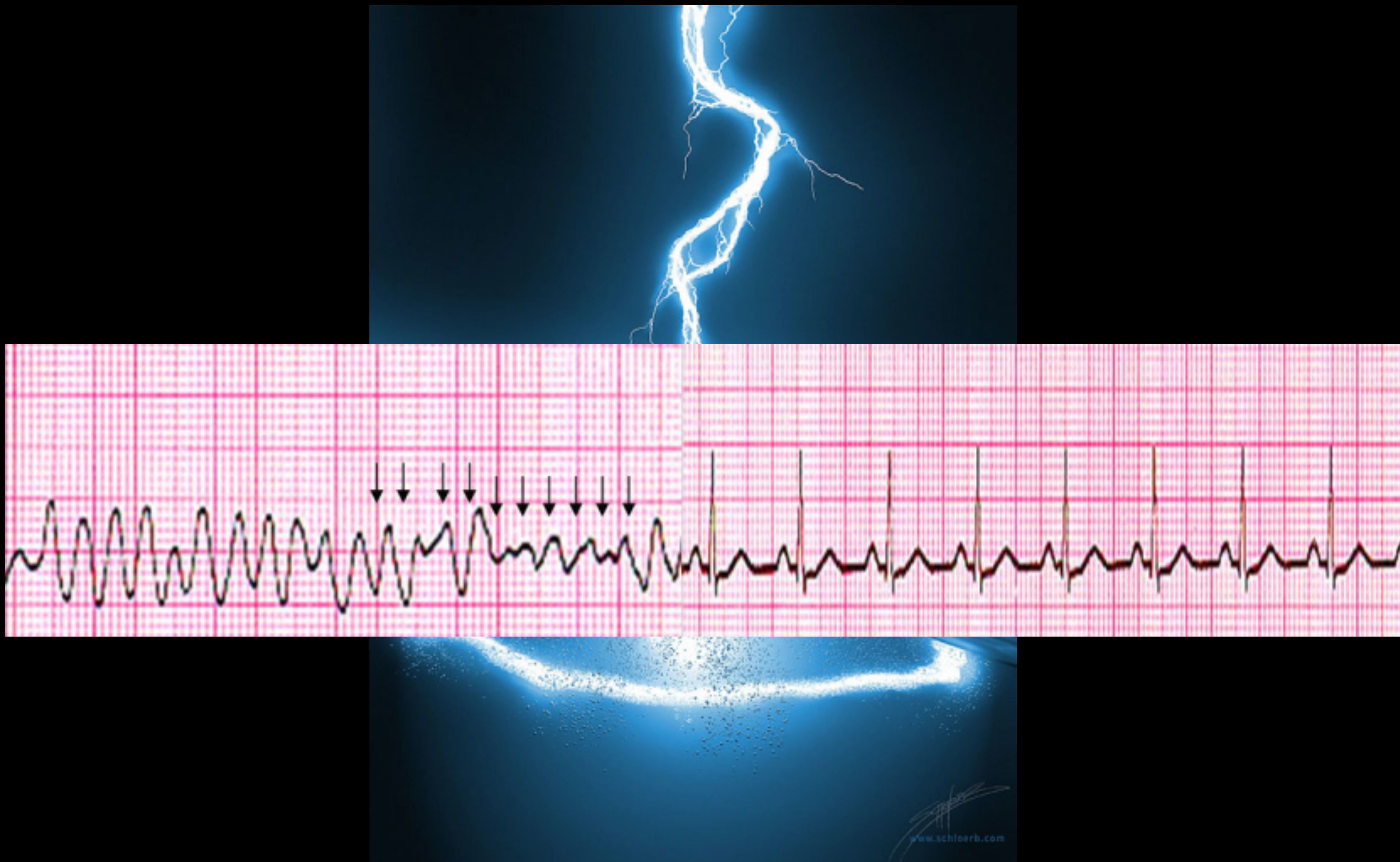
78 year-old man

- CPR initiated for 2 minutes



78 year-old man

- Intubated
- More CPR
- Epinephri
- Atropine
- Rhythm cl



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78 year-old man

- ROSC after 20 minutes from collapse
- Transported to local ED

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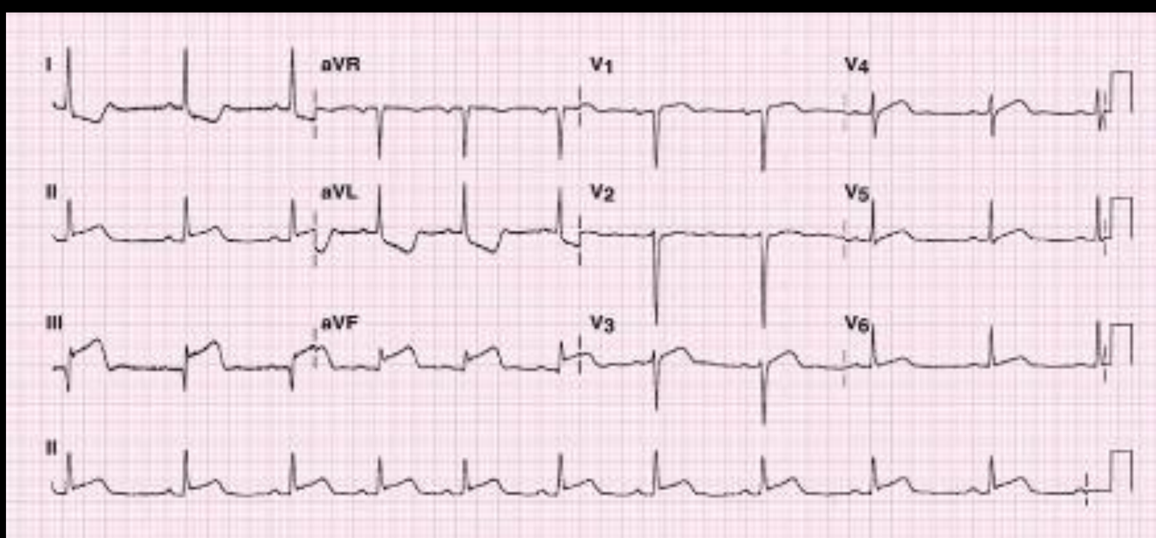
Emergency Department

- **Past Medical History**
  - Hypertension
  - Diabetes
  - Coronary Artery Disease
    - 2 stents 6 years ago
- **Medications**
  - Atenolol
  - ASA
  - Lipitor
  - Lisinopril
  - MVI



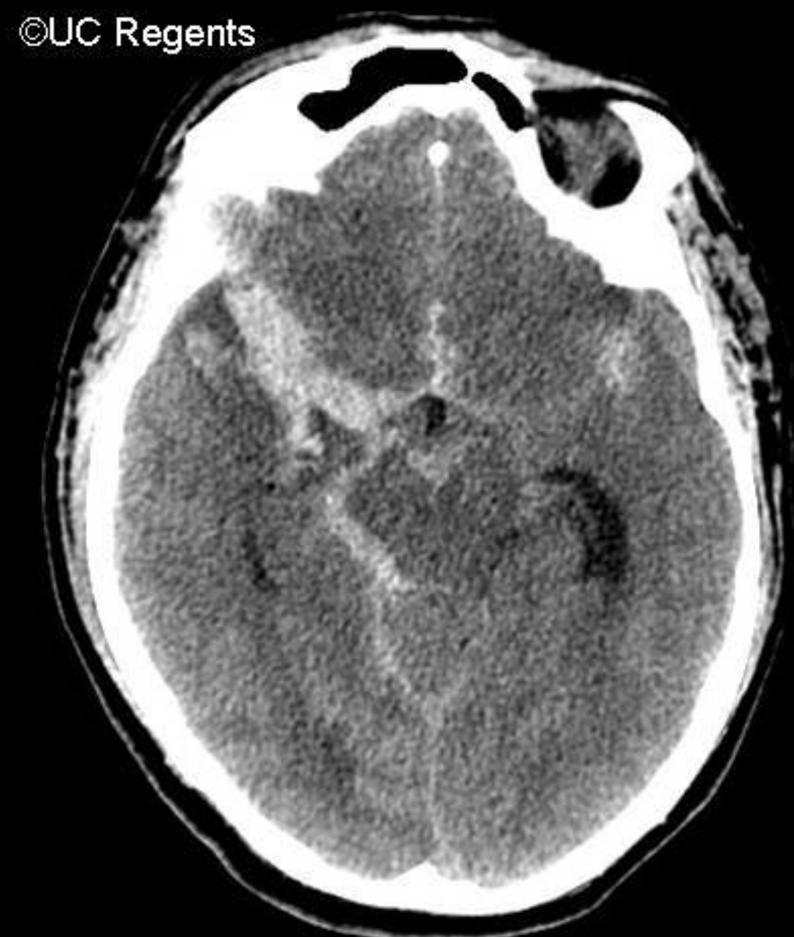
Emergency Department

- **BP 108/54**
- **HR 92**
- **RR 12(vent)**
- **SpO2 100% on 100% FiO2**

- **GCS 7**
  - E 2 – opens eyes to pain
  - V 1 – intubated
  - M 4 – withdraws from pain

Head CT

Because you don't want to miss…



Now what?

- What if he was on coumadin?
- What if he was down for 45 minutes?

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I'm not dead yet!

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The Problem

- High field mortality rate
- High in-hospital mortality rate
- Survivors have high neurologic morbidity

Objectives

- History
- Pathophysiology
- Practical application
- Initial Management
- Complications
- Case presentations

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Epidemiology

- **Incidence of sudden cardiac arrest**
  - 62 per 100,000 people (industrial countries)
  - 350,000 cases per year (US and Europe)
- **Despite nearly 40 years of ALS – survival rates are still very poor**
  - < ½ of those with ROSC survive to hospital discharge
- **Physician surveys show disappointing rates of hypothermia use**
  - 91% from US
  - 74% had never used hypothermia for cardiac arrest
    - Insufficient data available
    - Technically difficult
    - Not included in ACLS guidelines

Media

THE NATION'S NEWSPAPER

Special Reprint Edition

USA TODAY

NO. 1 IN THE USA

As seen in USA TODAY News Dec 11, 2006

To treat cardiac arrest, doctors cool the body

By Robert Davis
USA TODAY

When his heart stopped in the middle of his workday, Dean Cowles fell clinically dead in one of the best places in the world to suffer sudden cardiac arrest.

Media


Doctors are reinventing how they treat sudden cardiac arrest, which is fatal 95 percent of the time.
A report from
and death.
BACK FROM THE DEAD
BY JERRY ADLER
actly where he died: on the sidewalk outside his house in a retirement community in southern New Jersey. It was 10:30 on the night of May 23, a Wednesday, and Bondar was
APOPTOSIS: CELLULAR SUICIDE
THE GOP'S IRAQ REBELLION · MEN IN DRAG, AGAIN
Newsweek
This Man Was Dead.
He Isn't Anymore.
How Science Is Bringing More Heart-Attack Victims Back To Life
A New Route to Restoring Life
COLD THERAPY

Local Press

Cincinnati.Com
POWERED BY YOU AND THE
Enquirer • Community Press

GEAR UP SCORES!
UC | Cincinnati State | Cincinnati Youth Collaborative
Parents for Public Schools of Greater Cincinnati
Cincinnati REDS | Cincinnati Bengals | The Enquirer

News Cincinnati.Com » News
Last Updated: 4:48 pm | Monday, November 16, 2009

Hypothermia therapy saves Loveland man

BY BRIAN O'DONNELL • LOVELAND@COMMUNITYPRESS.COM • NOVEMBER 16, 2009

Comments (2) Recommend (2) Print this page ShareThis Font size: AA

When Thomas Hufford was diagnosed with prostate cancer last year, he had three treatment options, all of which would give him 10 to 15 years to live.

• **More Loveland news**

Hufford, a 76-year-old Loveland resident, chose to have radioactive seeds surgically implanted into his prostate to kill the cancer.

Immediately after the surgery, his life expectancy changed drastically when he suffered a massive heart attack.

Dr. Andrew Burger, a University Hospital physician, and his team expected a grim outcome.

Zoom | Buy This Photo

Brian O'Donnell/Contributor Thomas Hufford is called a medical miracle by his doctors at University Hospital.

Most Recommended Articles

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HD1 WVXU • HD2 Xponential Radio

Connecting You to a World of Ideas

[Focus on Technology]

Controlled hypothermia is helping restore life. Details during *Focus on Technology* with Ann Thompson.

By Ann Thompson

Listen to the MP3 (4:36)

XML Focus on Technology Podcasts

Debra Siegel, the patient, in her Hyde Park home

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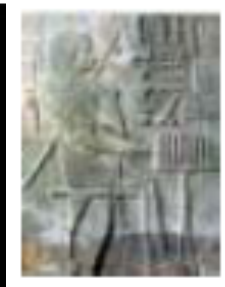
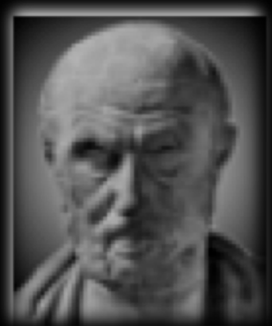
History of Hypothermia

- **First clinical reports on use of hypothermia published in the 1940s and 1950s**
- **Many studies on physiologic effects in humans performed in the 1950s**
- **Case series and experimental studies published in the 1950s and 1960s**
  - No randomized controlled trials
  - Moderate or deep hypothermia

History of Hypothermia



- **Described by ancient Egyptians, Greeks and Romans**



Hippocrates

Celcus en Galaenus

History of Hypothermia

- **1814 - Napoleonic Wars**

  Baron Larrey - Napoleon's surgeon-general

  - Wounded soldiers put close to a campfire died earlier than those who were not re-warmed

History of Hypothermia

- **First clinical reports published in the 1940s and 1950s**

Fay, T. Observations on Prolonged Human Refrigeration.
NY S J Med 1940; 40: 1351-1354

Bigelow WG et al, Ann Surg 1950, 132:531-537

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EARLY EXPERIENCES WITH LOCAL AND GENERALIZED REFRIGERATION OF THE HUMAN BRAIN*

TEMPLE FAY, M.D.†

Philadelphia, Pennsylvania

FIG. 5. Early method of total refrigeration with recording thermocouple (89.5°F. rectal). Patient was under Amytal Sodium, chloral hydrate and paraldehyde anesthesia. This patient (a physician) insisted upon keeping socks on.

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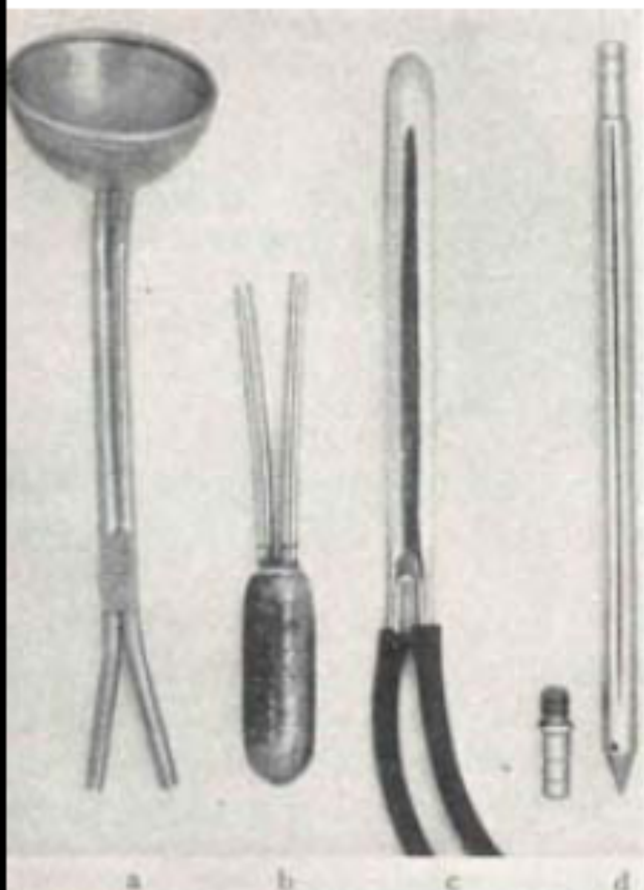


FIG. 8. With this mobile refrigeration apparatus, G.M. (April 9, 1940) was able to enjoy a fair degree of activity in the ward during the weeks of local refrigeration of the brain through an implanted capsule (Fig. 3) in the cavity of an evacuated glioma.

d

"SS [*Schutzstaffel* (protection echelon)] Sturmbannfuehrer Dr. Sigmund Rascher (right) and Dr. Ernst Holzloehner (left) observe the reactions of a Dachau prisoner who has been immersed in a tank of ice water in an attempt to simulate the extreme hypothermia suffered by pilots downed over frigid seas. The freezing experiments were designed to establish methods of treatment for persons in a state of shock as a result of prolonged exposure to the cold. The medical experiments performed on Dachau prisoners involved the placing of the victim in a tank of ice water until he lost consciousness (70-90 minutes), followed by abrupt attempts to restore his normal body temperature by various means.... This photo is taken from a film found in the Munich home of Dr. Sigmund Rascher."

most

World War II

- **Methods:**
  - – Immersion in ice-cold water
  - – Exposure to outside environment
  - – No interest in therapeutic hypothermia
  - – Research purely aimed at accidental hypothermia
    - Recovery from hypothermia

ANESTHESIA
&
ANALGESIA

[redacted]

VOLUME 38, NUMBER 6 — NOVEMBER-DECEMBER, 1959

Dr. Benson

Dr. Yates

THE USE OF HYPOTHERMIA AFTER CARDIAC ARREST

DONALD W. BENSON, M.D.
G. RAINEY WILLIAMS, JR., M.D.
FRANK C. SPENCER, M.D.
ADOLPH J. YATES, M.D.

Baltimore, Maryland*

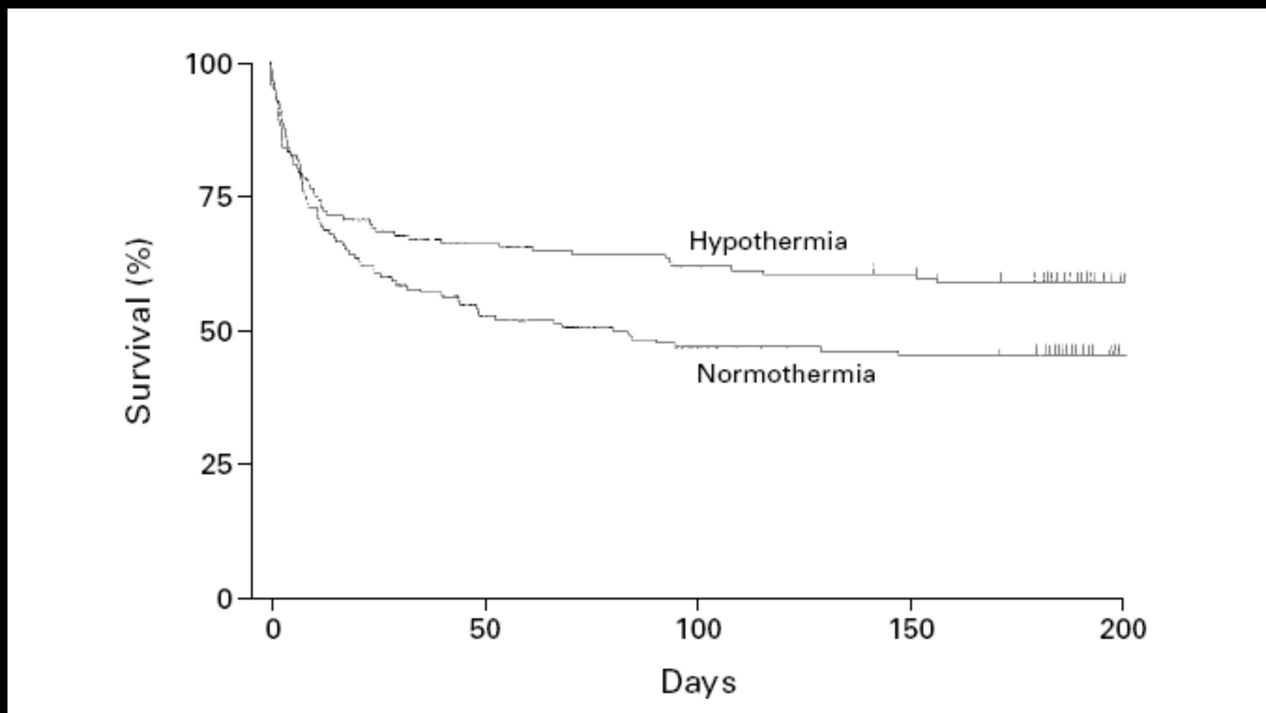
The New England Journal of Medicine

VOLUME 346 FEBRUARY 21, 2002 NUMBER 8

MILD THERAPEUTIC HYPOTHERMIA TO IMPROVE THE NEUROLOGIC OUTCOME AFTER CARDIAC ARREST

THE HYPOTHERMIA AFTER CARDIAC ARREST STUDY GROUP*

HACA 2002



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TREATMENT OF COMATOSE SURVIVORS OF OUT-OF-HOSPITAL CARDIAC ARREST WITH INDUCED HYPOTHERMIA

STEPHEN A. BERNARD, M.B., B.S., TIMOTHY W. GRAY, M.B., B.S., MICHAEL D. BUIST, M.B., B.S.,
BRUCE M. JONES, M.B., B.S., WILLIAM SILVESTER, M.B., B.S., GEOFF GUTTERIDGE, M.B., B.S., AND KAREN SMITH, B.SC.

The New England
Journal of Medicine

VOLUME 346 FEBRUARY 21, 2002 NUMBER 8

TABLE 1. CLINICAL CHARACTERISTICS OF THE 77 PATIENTS WITH ANOXIC BRAIN INJURY WHO WERE ELIGIBLE FOR RANDOMIZATION.*

CHARACTERISTIC	HYPOTHERMIA (N=43)	NORMOTHERMIA (N=34)	P VALUE
Age (yr)			0.55
Median	66.8	65.0	
Range	49–89	41–85	
Male sex (%)	58	79	0.05
Arrest witnessed (%)	95	94	0.81
Bystander-performed cardiopulmonary resuscitation (%)	49	71	0.03
Time from collapse to emergency-medical-services call (min)	2.1±1.9	2.7±3.0	0.32
Time from call to emergency-medical-services arrival (min)	7.9±3.1	8.3±2.8	0.60
Time from arrival to first DC shock (min)	2.5±2.2	2.0±1.2	0.22
Time from first shock to return of spontaneous circulation (min)	13.6±11.2	12.1±7.9	0.48
Time from collapse to return of spontaneous circulation (min)	26.5±12.9	25.0±8.9	0.54
Number of DC shocks	4.2±3.0	4.1±3.2	0.87
Dose of epinephrine (mg)	2.2±2.1	2.2±1.9	0.97

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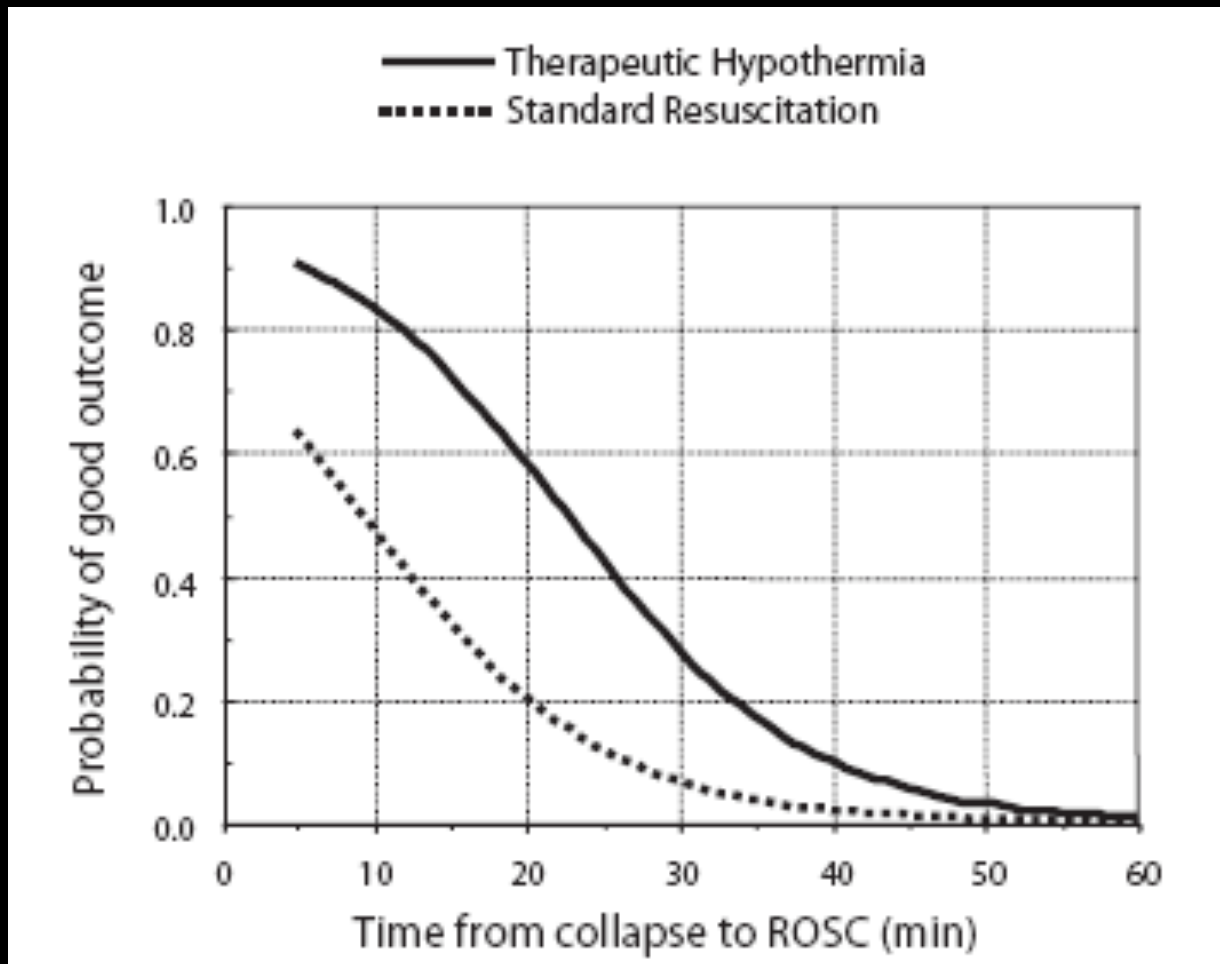

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The New England Journal of Medicine
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TABLE 5. OUTCOME OF PATIENTS AT DISCHARGE FROM THE HOSPITAL.

OUTCOME*	HYPOTHERMIA (N=43)	NORMOTHERMIA (N=34)
	number of patients	
Normal or minimal disability (able to care for self, discharged directly to home)	15	7
Moderate disability (discharged to a rehabilitation facility)	6	2
Severe disability, awake but completely dependent (discharged to a long-term nursing facility)	0	1
Severe disability, unconscious (discharged to a long-term nursing facility)	0	1
Death	22	23

Critical Care Medicine
OFFICIAL JOURNAL OF THE SOCIETY OF CRITICAL CARE MEDICINE

2005

Hypothermia for neuroprotection after cardiac arrest: Systematic review and individual patient data meta-analysis

Michael Holzer, MD; Stephen A. Bernard, MD; Said Hachimi-Idrissi, MD; Risto O. Roine, MD, PhD; Fritz Sterz, MD; Marcus Müllner, MD, MSc on behalf of the Collaborative Group on Induced Hypothermia for Neuroprotection After Cardiac Arrest

Number Needed to Treat

6

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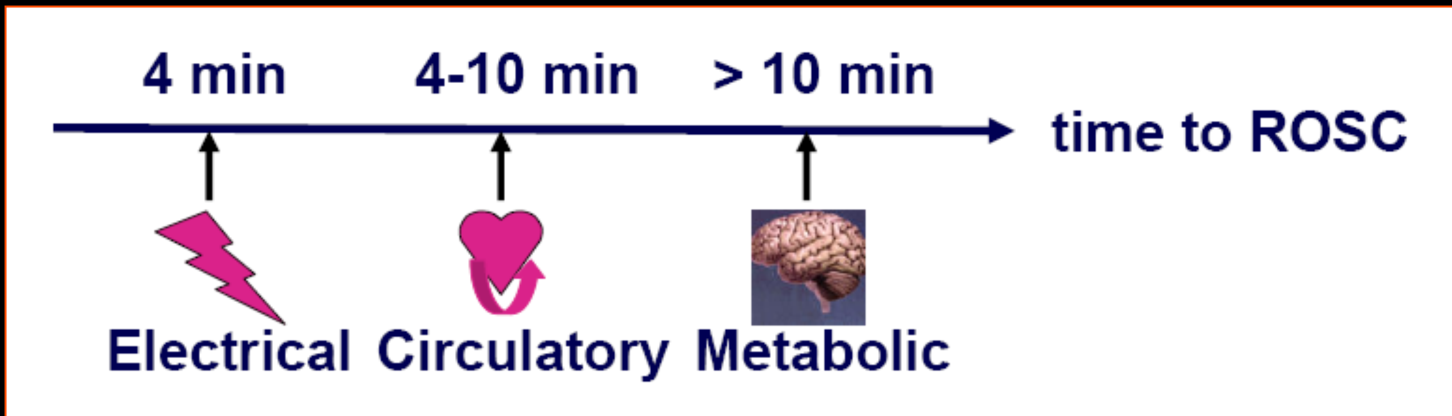
How does it work?

istitute

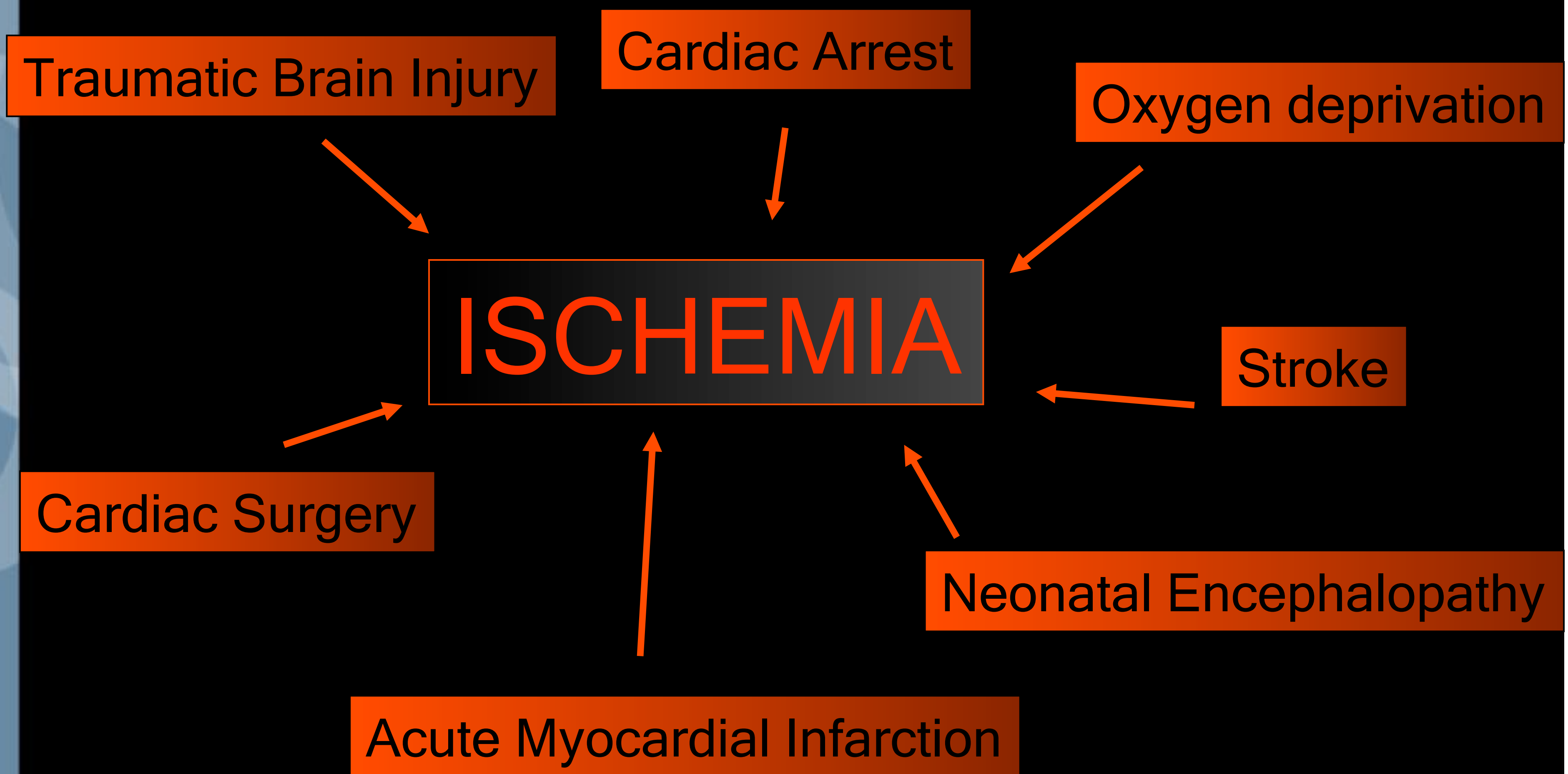
3 phase model of resuscitation



Electrical and Circulatory → reduce the duration of global ischemia (primary brain injury)

Metabolic → attenuate post-resuscitation disease due to reperfusion injury (secondary brain injury)

Common denominator?



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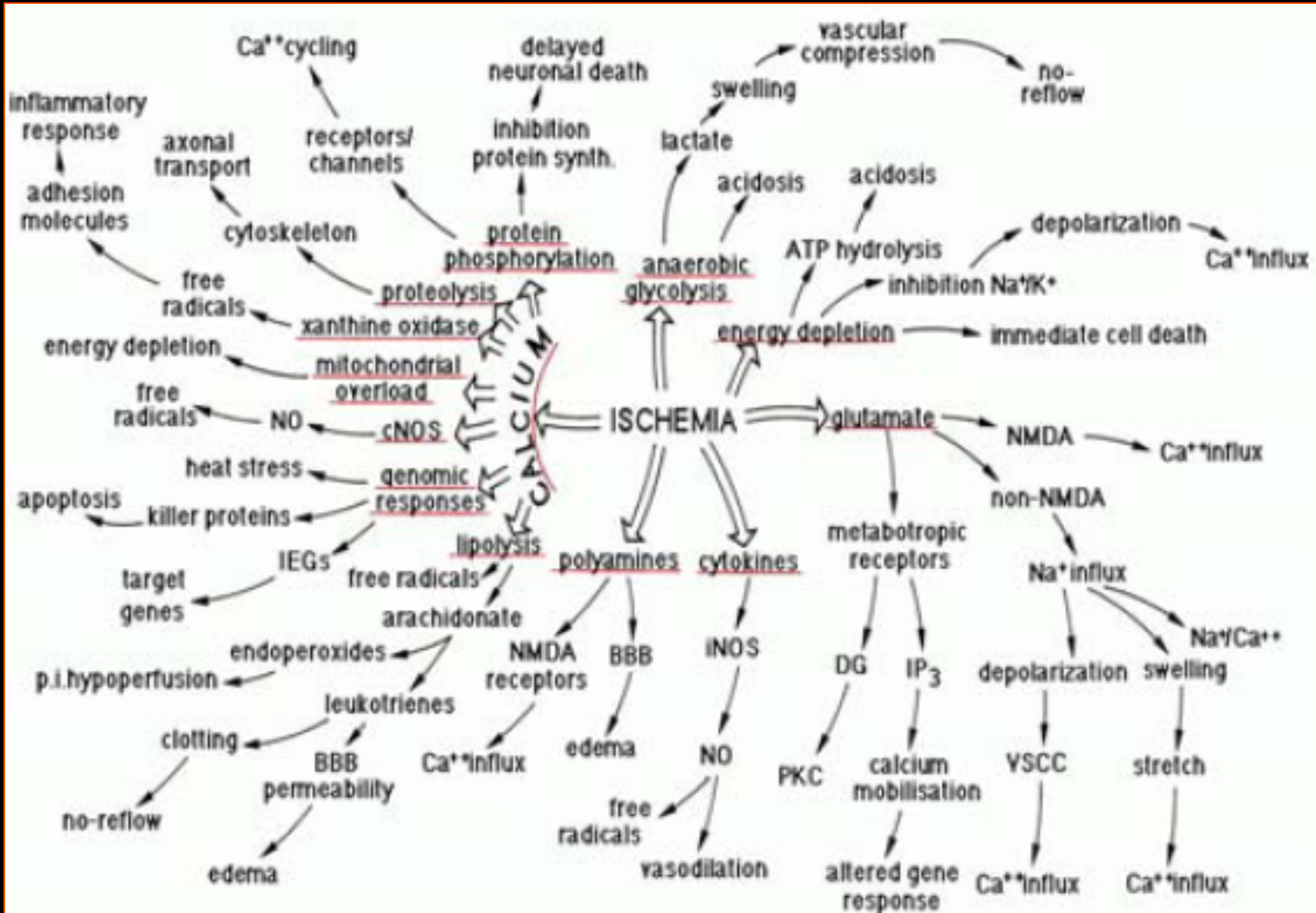
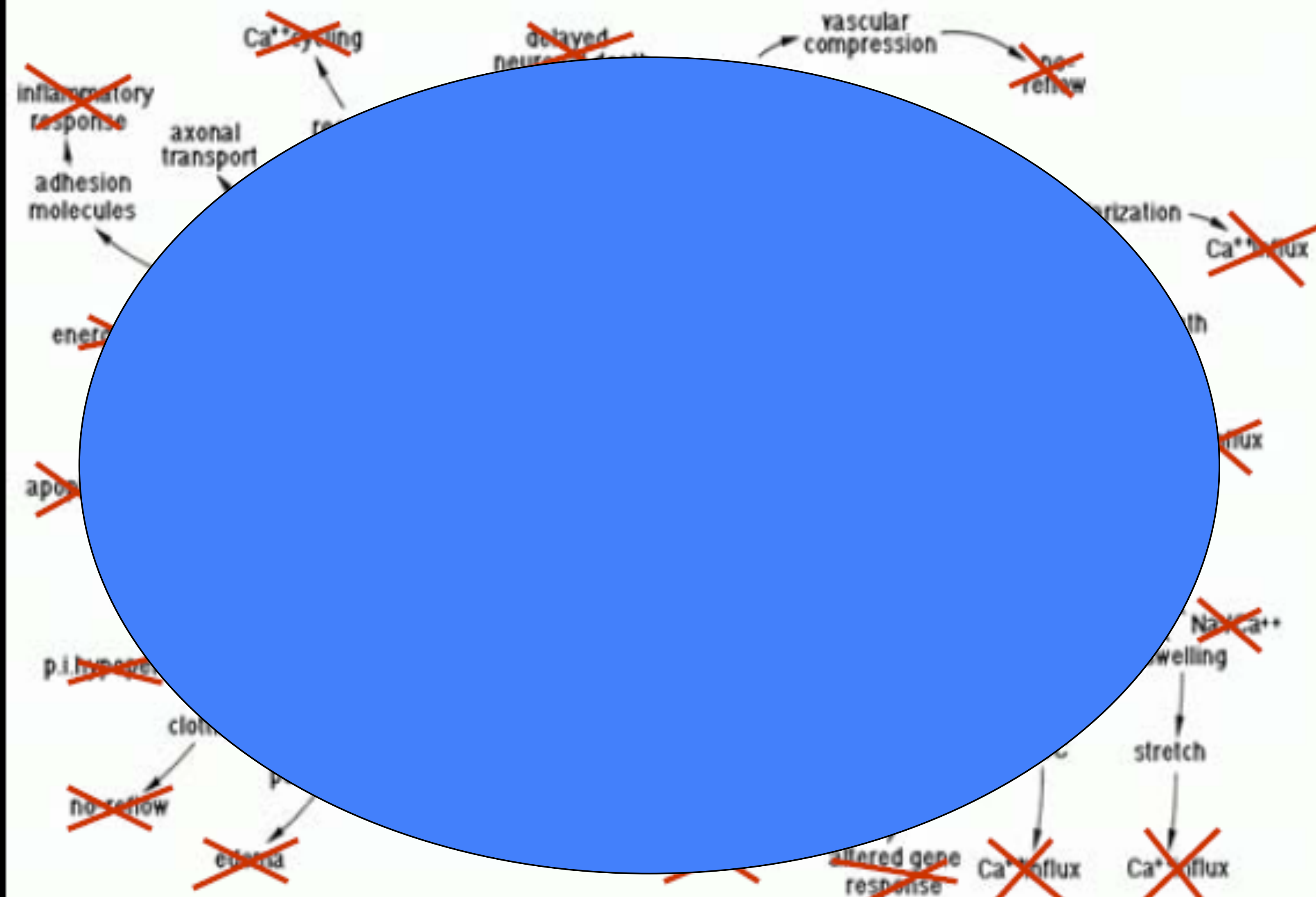
Simplified scheme of the mechanisms of ischemia



Effects of Mild Hypothermia



Complications of Hypothermia

- **Most significant complications are related to degree of hypothermia**
  - Hypothermia abandoned for 40+ years!
- **Strict adherence to MILD (32-34ºC) hypothermia**
  - Do not overcool
- **Complications most prominent with deep hypothermia**
  - (>30ºC)

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HACA Study

TABLE 4. COMPLICATIONS DURING THE FIRST SEVEN DAYS AFTER CARDIAC ARREST.*

COMPLICATION	NORMOTHERMIA	HYPOTHERMIA
	no./total no. (%)	
Bleeding of any severity†	26/138 (19)	35/135 (26)
Need for platelet transfusion	0/138	2/135 (1)
Pneumonia	40/137 (29)	50/135 (37)
Sepsis	9/138 (7)	17/135 (13)
Pancreatitis	2/138 (1)	1/135 (1)
Renal failure	14/138 (10)	13/135 (10)
Hemodialysis	6/138 (4)	6/135 (4)
Pulmonary edema	5/133 (4)	9/136 (7)
Seizures	11/133 (8)	10/136 (7)
Lethal or long-lasting arrhythmia	44/138 (32)	49/135 (36)
Pressure sores	0/133	0/136

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EDREC

Hypothermia for Cardiac Arrest
Timed Flowsheet

Cause of arrest (if known) ____________________
Initial rhythm (if known) ____________________
Time to CPR (downtime - if known)

Please stamp here

Time of arrest
Time of Return of Spontaneous Circulation ____________
Time NSICU fellow called ____________
Time Cooling Initiated ____________
Time Target Temperature Obtained ____________

Flow sheet starts at time target temperature is obtained

Time	Hours	Temperature	Action	Labs due	Sent by?
	Cooling + 1				
	Cooling + 2			EP-1, Mg, Phos, ScvO2	
	Cooling + 3				
	Cooling + 4			ScvO2	
	Cooling + 5				
	Cooling + 6			ABG, ScvO2, EP-1, lactate	
	Cooling + 7				
	Cooling + 8				
	Cooling + 9				
	Cooling + 10				
	Cooling + 11				
	Cooling + 12			ABG, ScvO2, EP-1, lactate	
	Cooling + 13				
	Cooling + 14				
	Cooling + 15				
	Cooling + 16				
	Cooling + 17				
	Cooling + 18			ABG, ScvO2, EP-1, lactate	
	Cooling + 19				
	Cooling + 20				
	Cooling + 21				
	Cooling + 22				
	Cooling + 23				
	Cooling + 24			ABG, ScvO2, EP-1, lactate	
	Rewarm + 1				
	Rewarm + 2			EP-1	
	Rewarm + 3				
	Rewarm + 4			EP-1	
	Rewarm + 5				
	Rewarm + 6			EP-1	
	Rewarm + 7				
	Rewarm + 8			EP-1	

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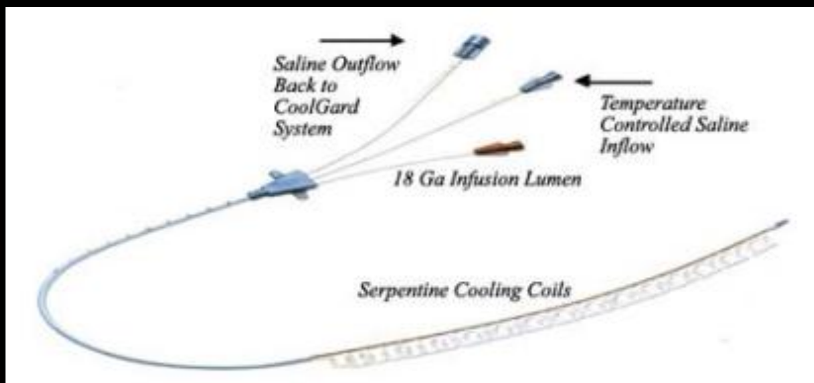
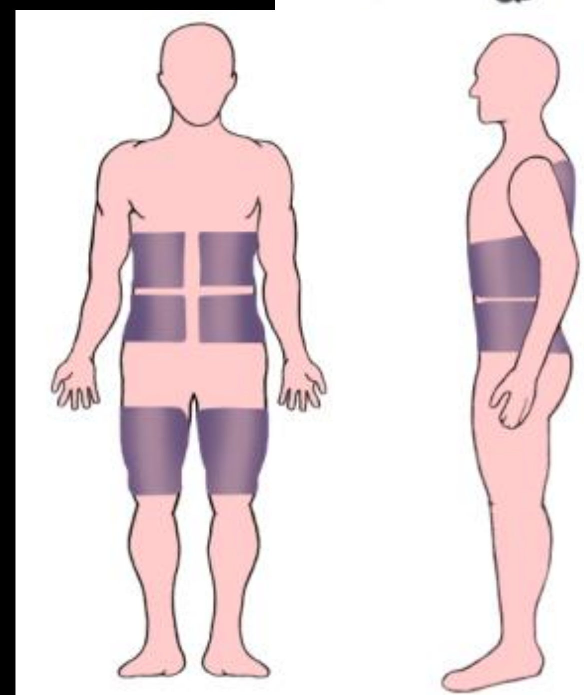
Institute concurrently with reperfusion

Do not delay one therapy for the other

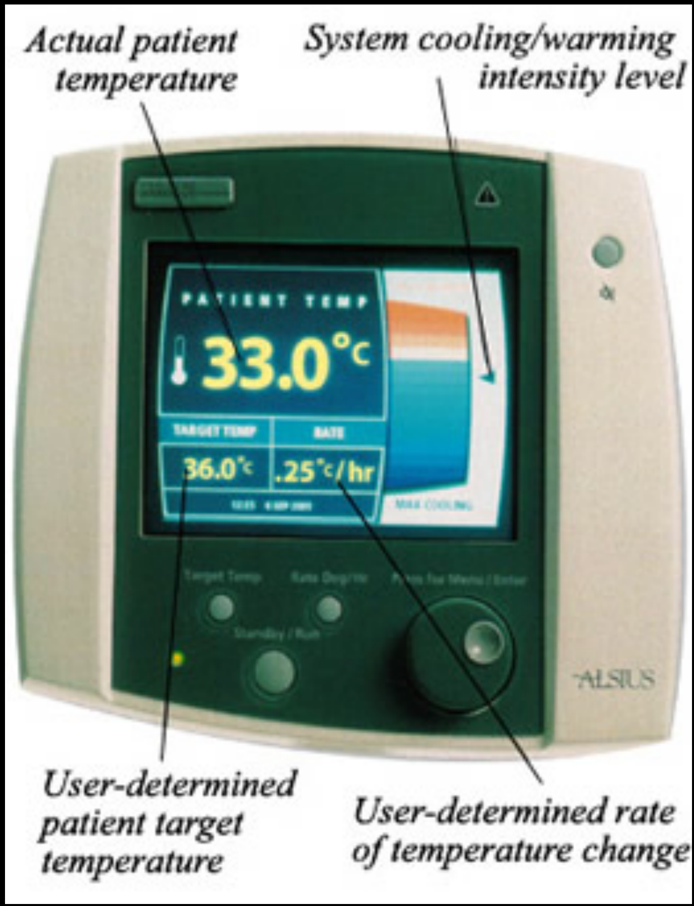
Practical Applications



CSZ
Cincinnati Sub-Zero



New Technology



Barriers

Institutional sandbox

Optimal cooling devices

Consultant buy-in

Busy ED

Reimbursement – no specific billing code to justify cooling devices

ANNALS *of Neurology*

Prognostication after Cardiac Arrest and Hypothermia
A Prospective Study

Andrea O. Rossetti, MD,[1] Mauro Oddo, MD,[2]
Giancarlo Logroscino, MD, PhD,[3] and Peter W. Kaplan, MBBS, FRCP[1,4]

TABLE 1: Frequency of Occurrence of Clinical and Electrophysiological Characteristics of Survivors and Nonsurvivors of CA at Hospital Discharge

Characteristic	Survivors	Nonsurvivors	*p*	Test
Patients, No. (%)	45 (41)	66 (59)		
Age, mean yr ± SD (range)	60.2 ± 14.9 (17–85)	58.8 ± 14.7 (22–84)	0.630	*t*
Female gender, No. (%)	7/45 (16)	15/66 (22)	0.468	Fisher
Noncardiac etiology, No. (%)	3/45 (7)	13/66 (20)	0.166	Fisher
Non-VF CA (asystole or PEA), No. (%)	7/45 (16)	38/66 (58)	<0.001	Fisher
ROSC >25 minutes, No. (%)	11/45 (24)	43/66 (65)	<0.001	Fisher
≥1 brainstem reflexes absent,[a] No. (%)	2/45 (4)	45/66 (68)	<0.001	Fisher
Motor response worse than flexion, No. (%)	11/45 (24)	58/66 (88)	<0.001	Fisher
Early myoclonus, No. (%)	2/45 (4)	35/66 (53)	<0.001	Fisher
Epileptiform activity on the first EEG, No. (%)	4/45 (9)	35/65 (54)	<0.001	Fisher
Unreactive EEG background, No. (%)	3/45 (8)	53/65 (81)	<0.001	Fisher
Bilaterally absent N20 on the SSEP, No. (%)	0/44 (0)	33/56 (59)	<0.001	Fisher
Time to first EEG, median days, range (No. of subjects)	2, 1–4 (45)	2, 1–5 (65)	0.319	*U*
Time to SSEP, median days, range (No. of subjects)	2.5, 1–6 (44)	2, 1–8 (56)	0.341	*U*

[a]Pupillary, oculocephalic, corneal.
CA = cardiac arrest; SD = standard deviation; VF = ventricular fibrillation; PEA = pulseless electrical activity; ROSC = return of spontaneous circulation; EEG = electroencephalography; SSEP = somatosensory evoked potentials.

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Connecting You to a World of Ideas

[Focus on Technology]

Controlled hypothermia is helping restore life. Details during *Focus on Technology* with Ann Thompson.

By Ann Thompson

Listen to the MP3 (4:36)

XML Focus on Technology Podcasts

Debra Siegel, the patient, in her Hyde Park home

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Prognosis

- No reliable markers of prognosis available

- Certainly not in the first 24 hours!

Return to the case…

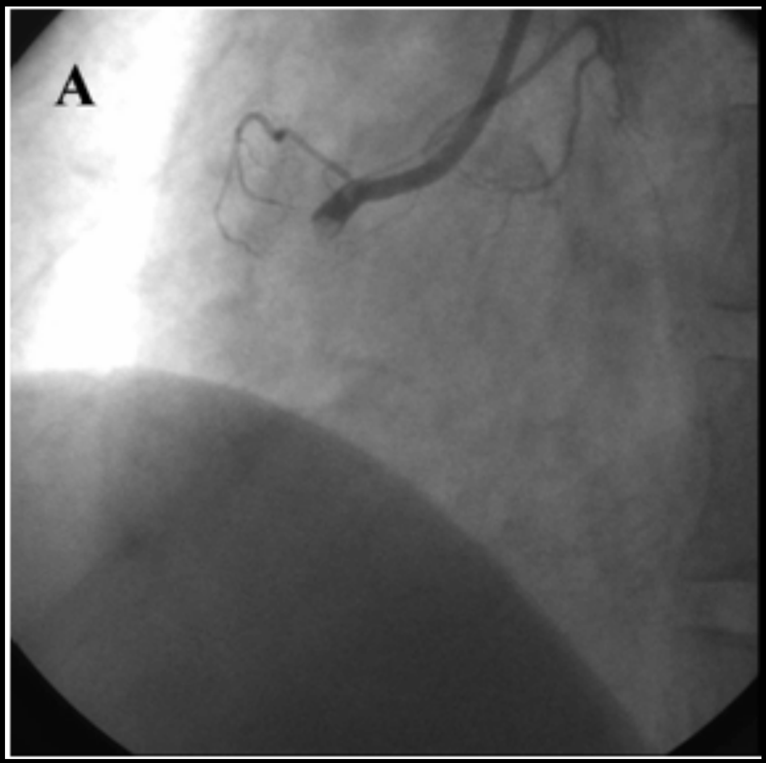
- Cath lab activated…

- 2 liters normal saline IV (4°C) infused
- Icepacks to neck, axillae, trunk and groin

- BP drops to 80/40
- HR 90s
- Levophed gtt initiated 5μg/min

- Transported to Cath Lab

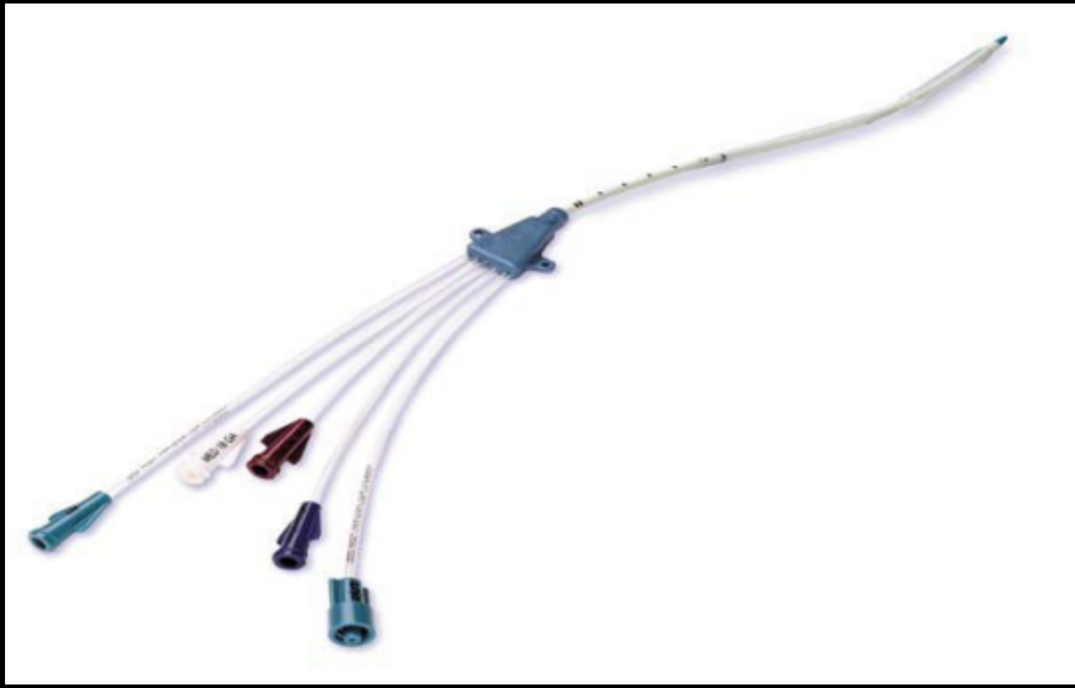
Cath Lab

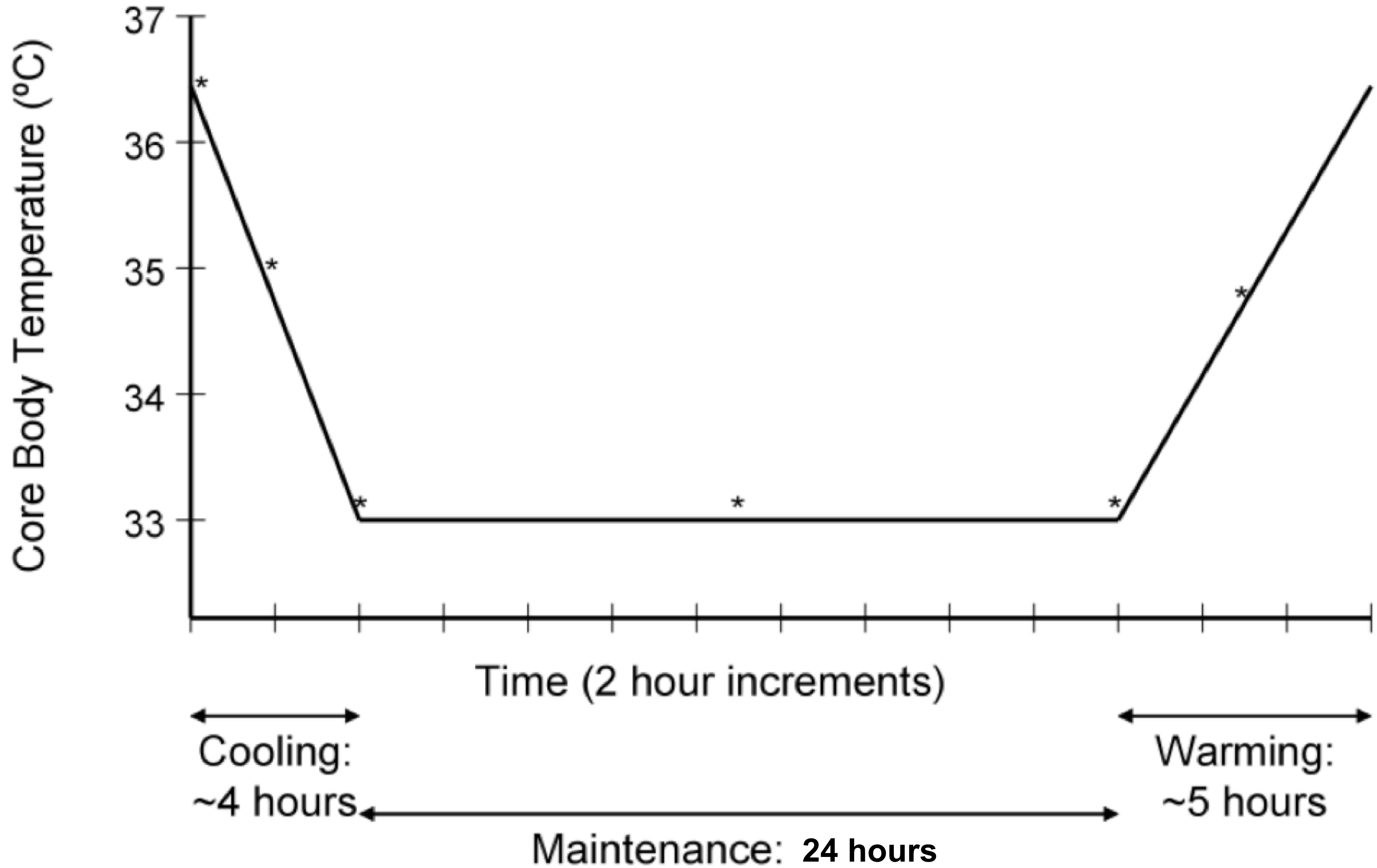


- **100% RCA occlusion**
  - Successfully stented
  - TIMI 3 flow

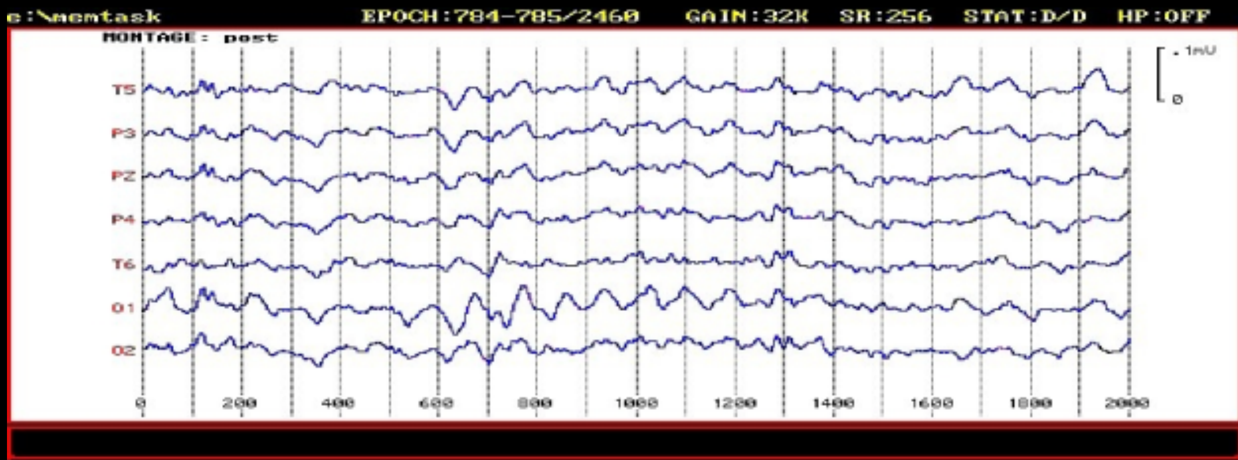
Cardiovascular ICU

- **Zoll Alsius Thermoguard Catheter placed**
  – Neurocritical Care consult





Vital signs recorded every hour
IV sedation throughout
IV paralytics until temperature ≥36 ºC
Labs drawn at asterisks


e:\memtask
EPOCH:784-785/2460
GAIN:32K
SR:256
STAT:D/D
HP:OFF
MONTAGE: post
1mV
0
T5
P3
PZ
P4
T6
O1
O2
0
200
400
600
800
1000
1200
1400
1600
1800
2000

ICU Course

- Maintained intubated, sedated and paralyzed for 24 hours
- Required levophed for 30 hours
- No seizures were noted
- Rewarmed at 0.3°C/hr

ICU Course

- Followed commands on HD 2
- Extubated on HD 3
- Discharged to home on HD 6

Future Directions

- **State of the art equipment**
- **Hypothermia Resuscitation becomes primary focus**
  - Application to other disease processes?
    - TBI
    - Stroke
    - SAH
- **Hypothermia Resuscitation Teams**
  - Early Goal Directed Therapy?
  - EMS bypass non-cooling centers?

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Questions?

nstitute

References

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- **Selected slides from**
  - www.cpqe.com
  - www.sccm.com/criticalconnections
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  - Kees Polderman, MD
    - *Hypothermia for Cardiac Arrest: European Experience*. Columbia University 5th Symposium on Neurologic Emergencies and Neurocritical Care. June 5, 2008
  - Kees Polderman, MD
    - *History of Hypothermia*. Columbia University 5th Symposium on Neurologic Emergencies and Neurocritical Care. June 5, 2008
  - Mauro Oddo, MD
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