New Therapeutic Hypothermia Techniques

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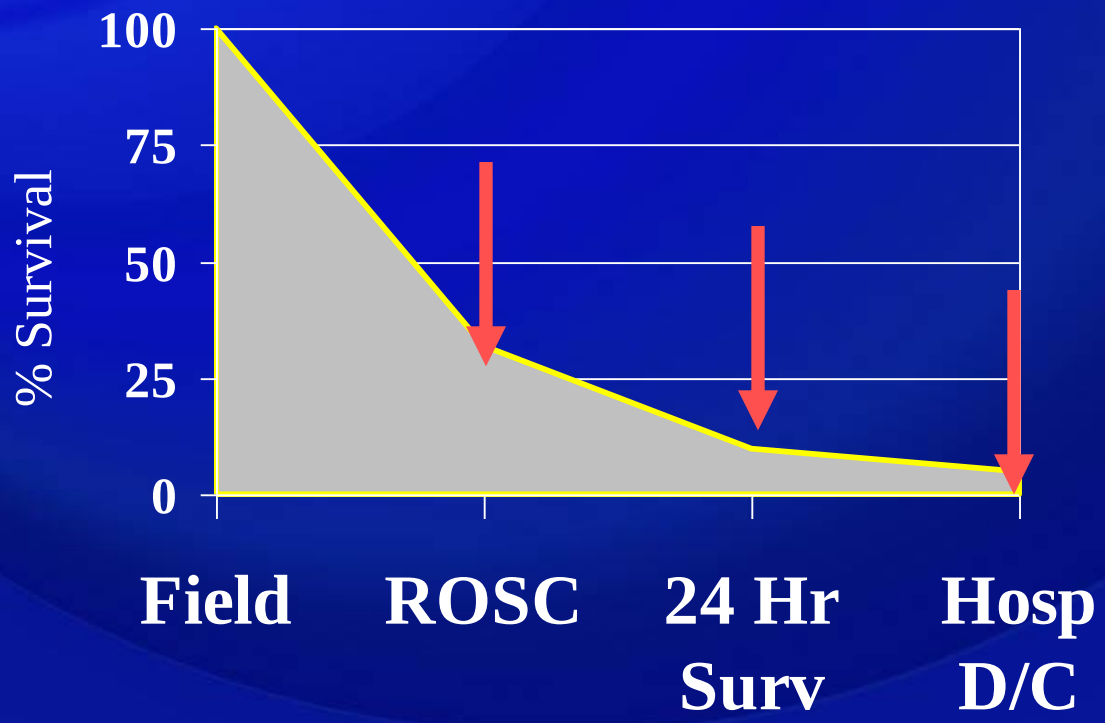
Out of Hospital Cardiac Arrest Survival

- 30% ROSC rate
- 10% survive 24h
- 4% survive to hospital discharge



Weil and Tang. 1999, CPR

BRAIN INJURY is the most common cause of death after initial resuscitation from sudden cardiac arrest

Metabolic Chain of Events in Cardiac Arrest

Cardiac Arrest

No Blood Flow → Cerebral Ischemia → Cell Damage

CPR / Pulse

O_2 Reperfusion → Free Radicals

Cell Death and Cerebral injury

Hypothermia: Mechanism of Action

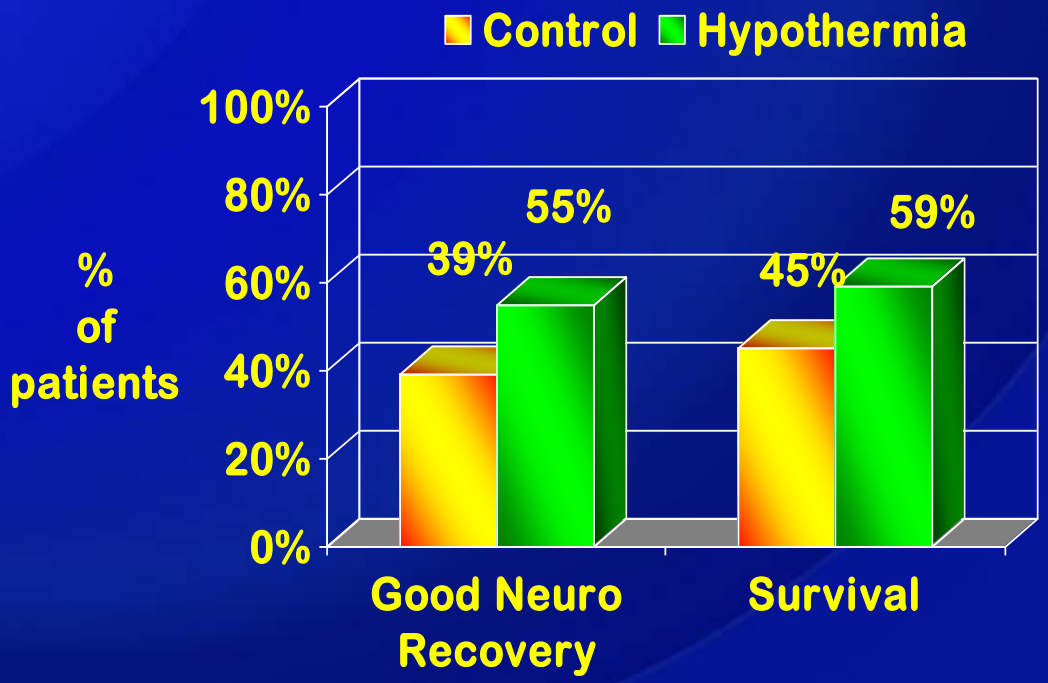
- Decrease of O_2 consumption
- Decrease production of free radicals
- Decrease enzyme synthesis and reactions
- Decrease of excitatory NT synthesis
- Decrease of intracellular acidosis
- Decrease intracellular Ca++
- Decrease in cerebral edema and ICP
- Protection of membrane fluidity

Induced Hypothermia (32-34º C)

The Hypothermia after Cardiac Arrest Study Group

N Engl J Med 2002; 346 : 549-556

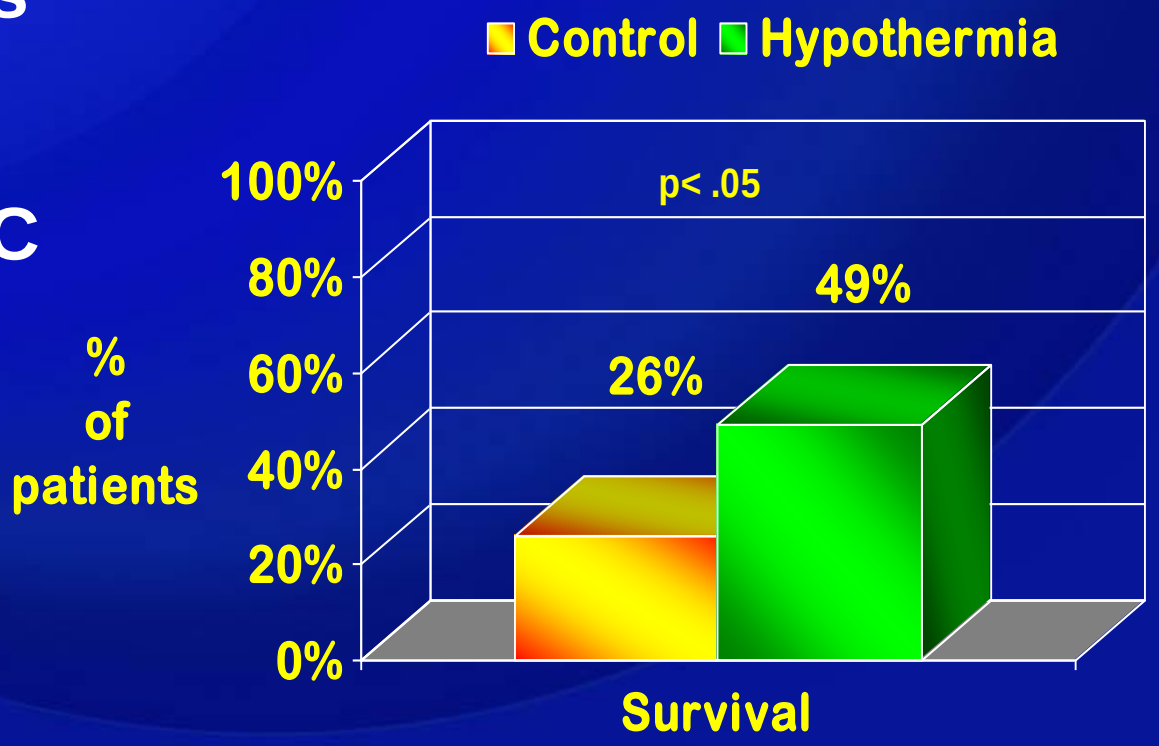
- 7 European EDs
- 275 VT/VF pts with ROSC
- Cooled to 32-34º C using an external cooling device +/- ice packs for 24 h
- Sedated with midazolam and fentanyl, paralysed with pancuronium
- 6 month follow-up



Induced Hypothermia (33º C)

Bernard SA et al. N Engl J Med 2002; 346 : 557-63

- **Australian study**
- **73 OOH-CA pts with ROSC**
- **Cooled to 33º C for 12 h**



Cooling Techniques

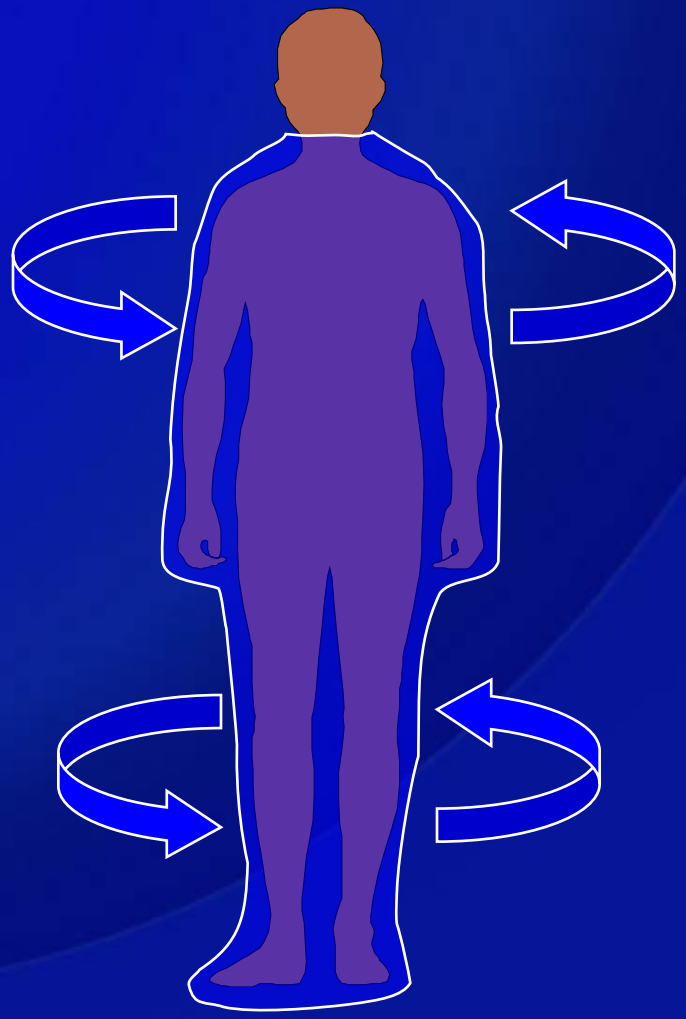
- **External Cooling**
  - Ice packs
  - Cooling blankets
  - External cooling equipment
    - Conductive surface pads
    - Submersion
- **Internal Cooling**
  - Cooled IV saline
  - Iced lavage
  - Intravascular catheter
  - Selective brain cooling

Surface Cooling

Cooling Blankets

Surface Cooling
Arctic Sun

The LRS ThermoSuit® System



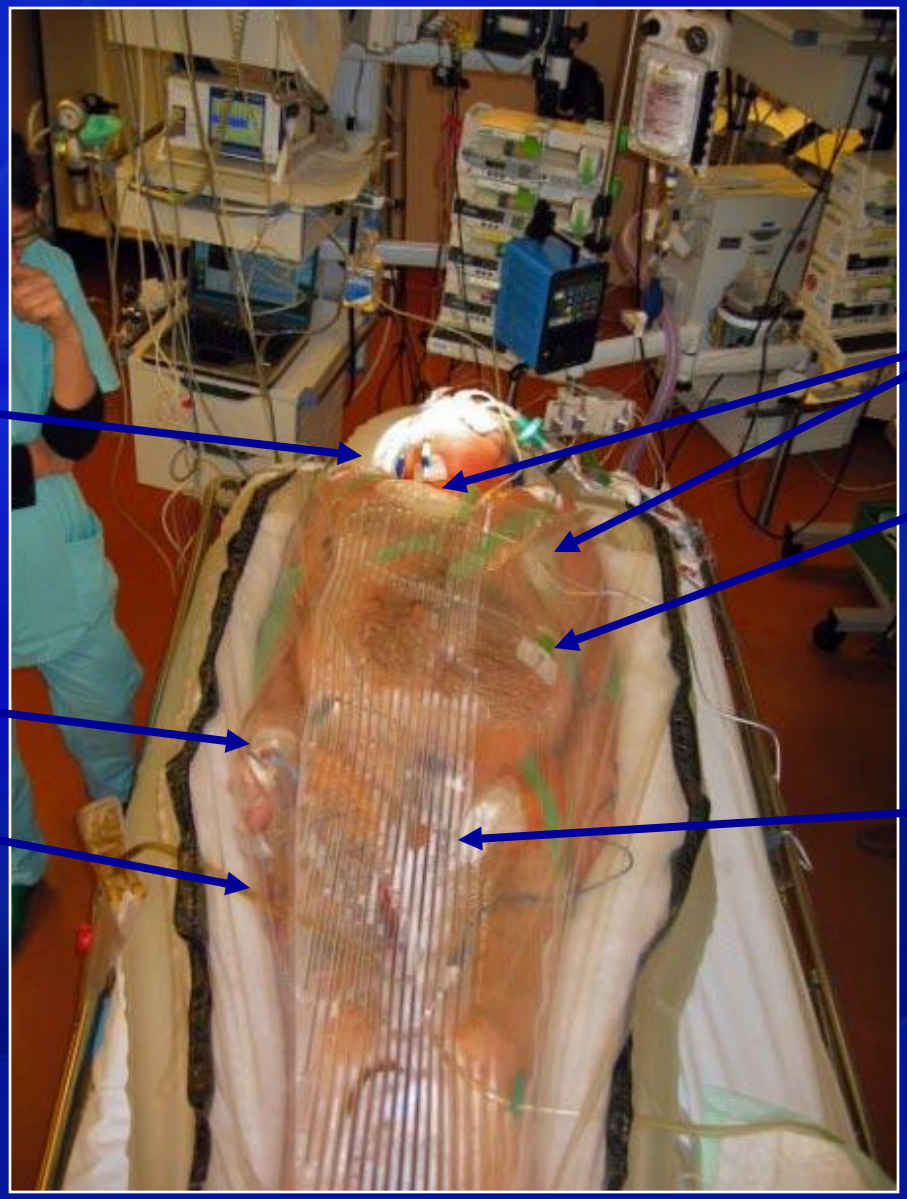
ThermoSuit® - Patient Access

Typical Venous Access Sites:

Jugular

Subclavian

Cephalic



AED Pads

ECG Electrodes

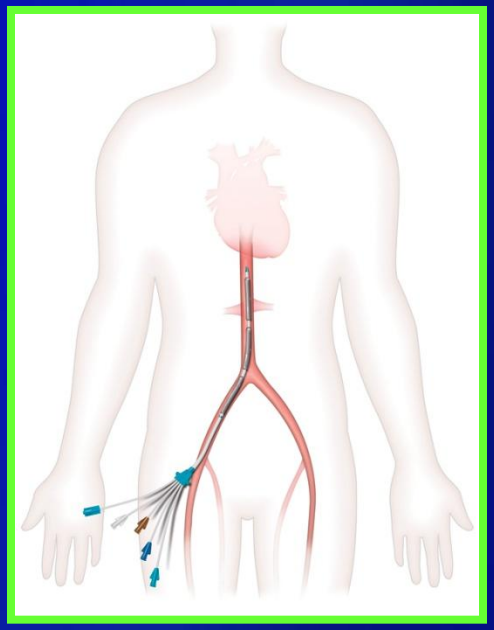
Radial Arterial Line

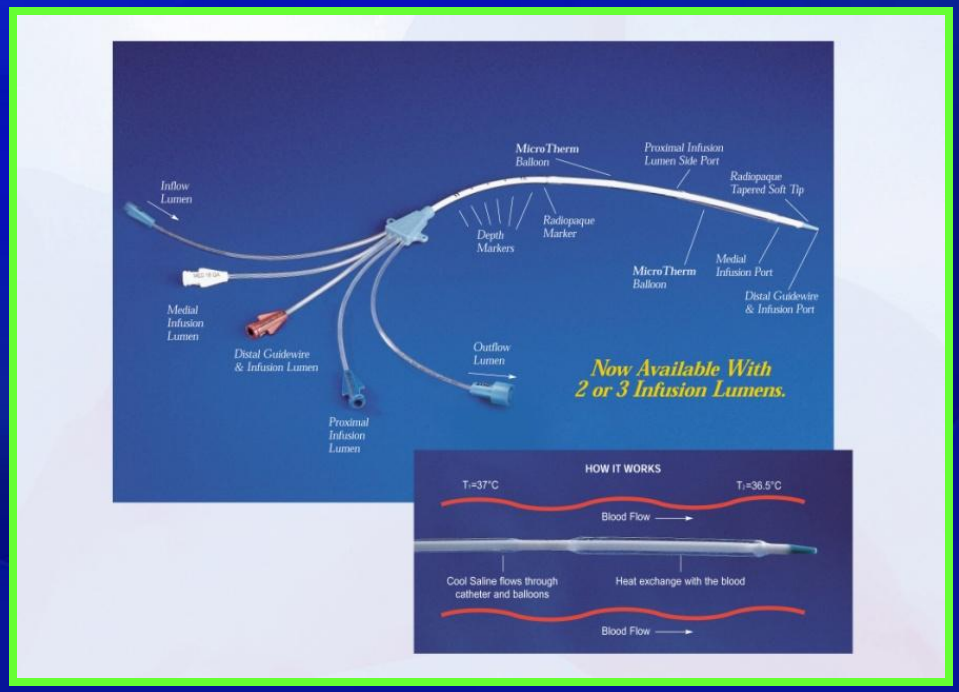
Rectal Catheter

Urinary Catheter

Intravascular Cooling

Alsius Device



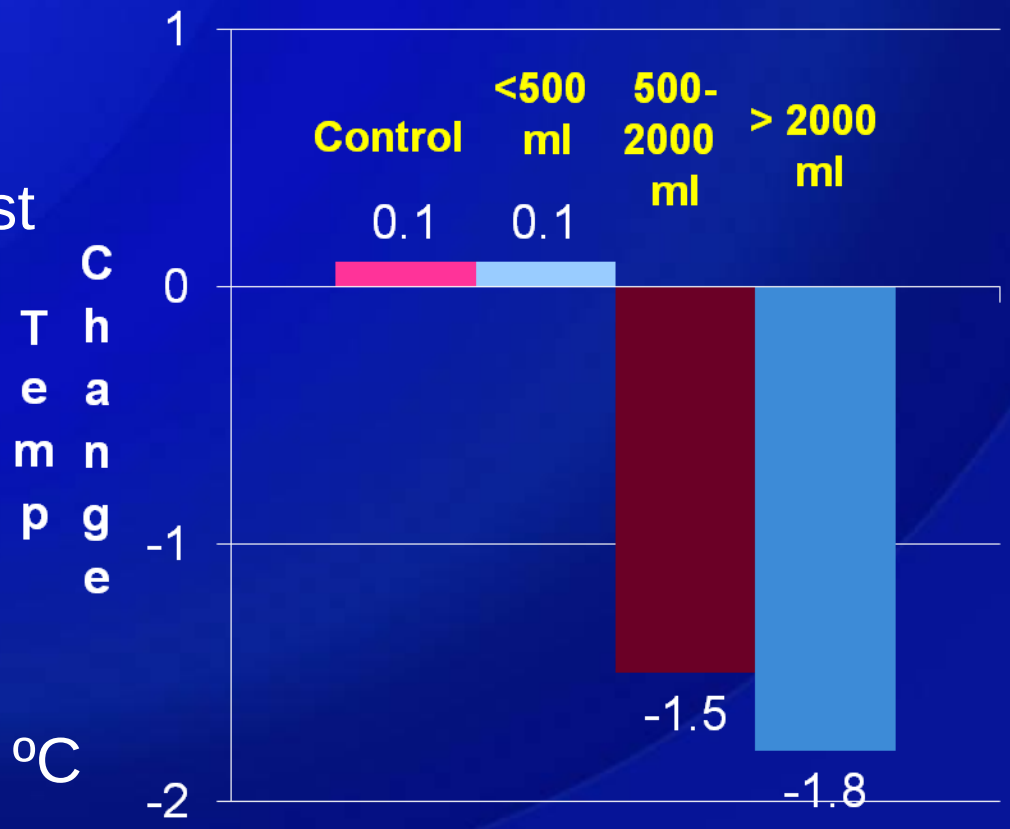


Cooled IV Fluid Infusion

Pilot Randomized Trial of Prehospital Induction of Hypothermia in OOH-CA with Rapid Infusion of 4ºC Saline

Kim et. al. Circ 2007;115:3064-3070

- 7 paramedic units
- 9 receiving hospitals
- Adult, non-traumatic arrest
- All rhythms
- Esophageal temp >34C
- Intubated
- Unresponsive
- IV access
- Mean temp change= -1.2 ºC



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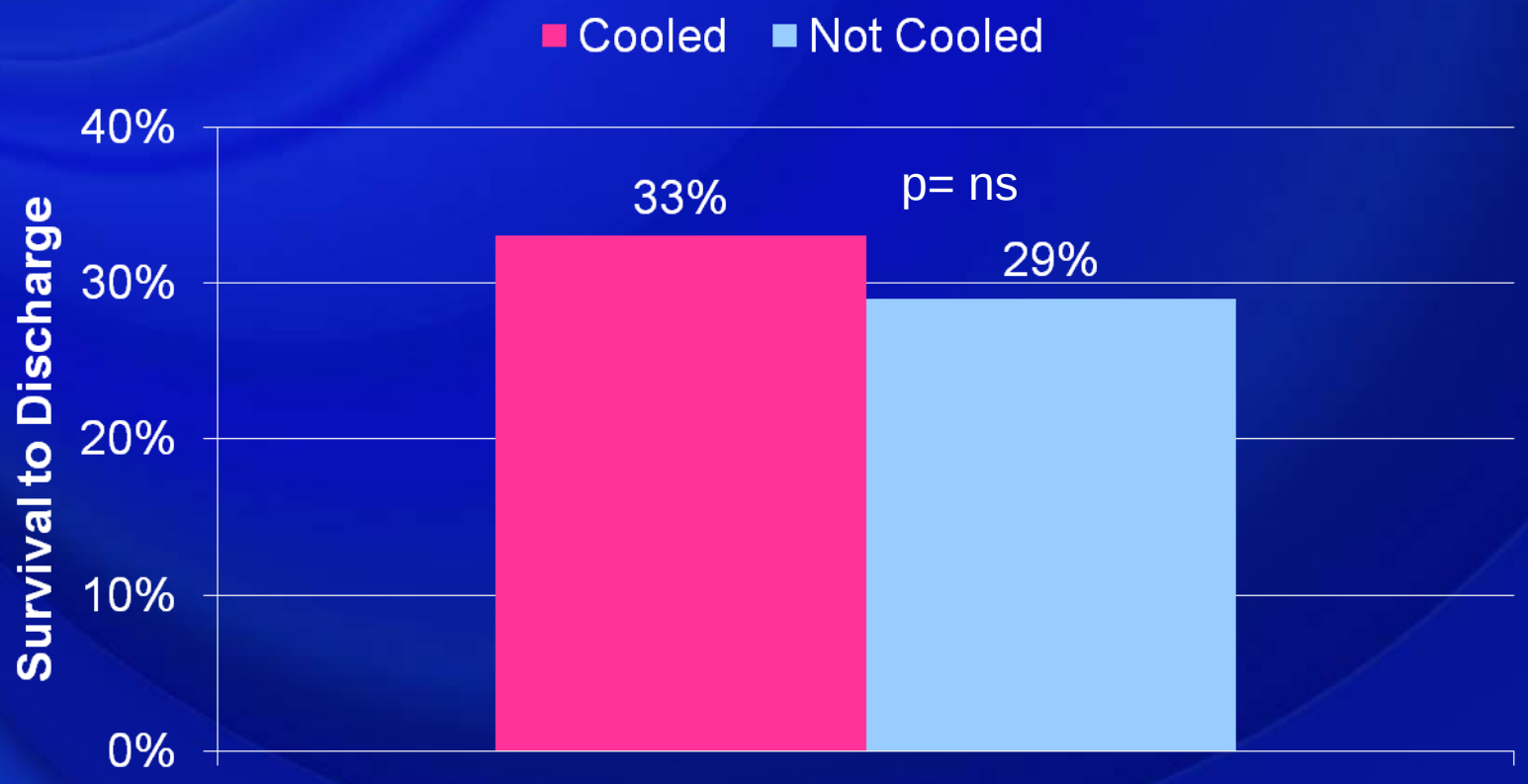

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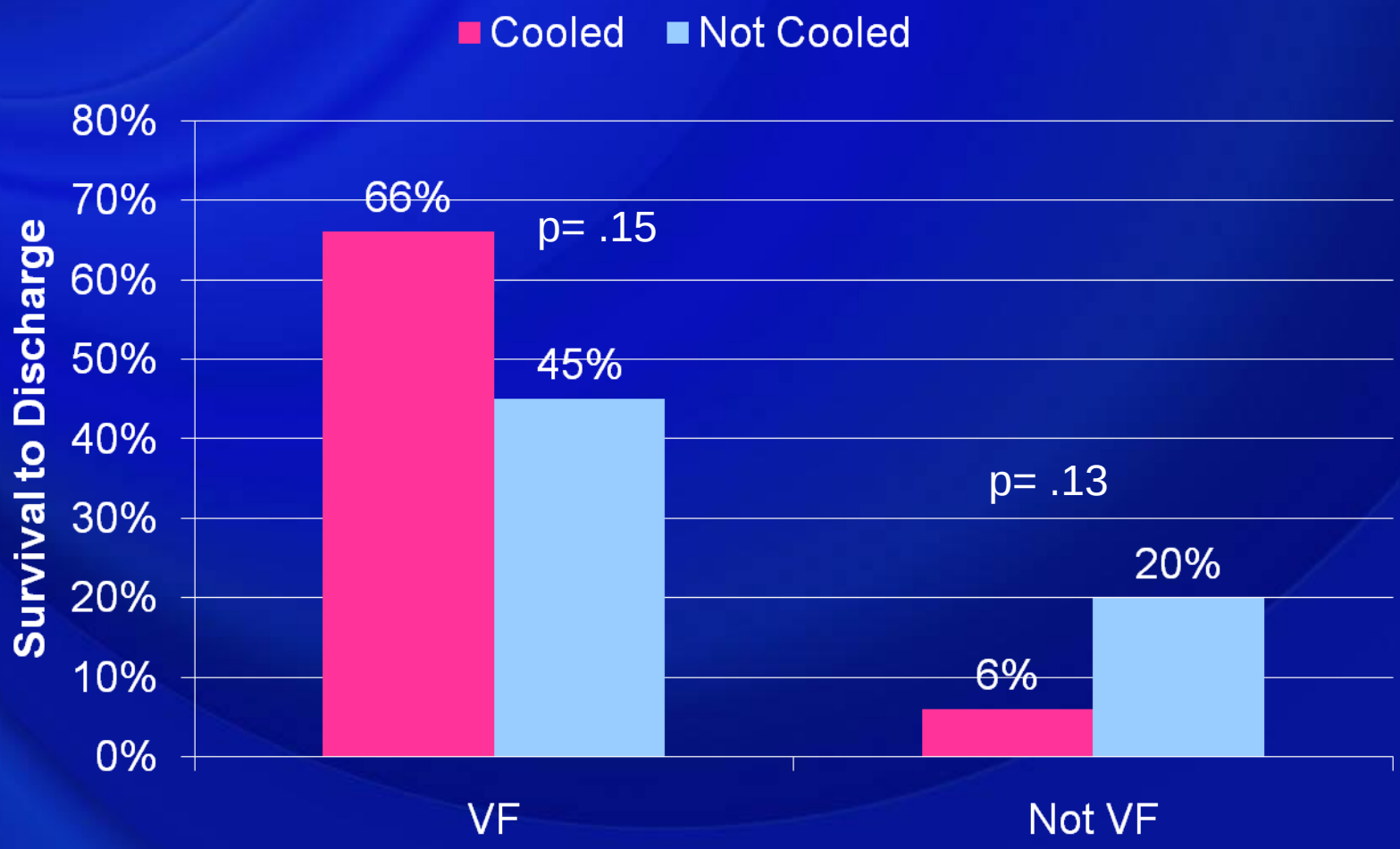


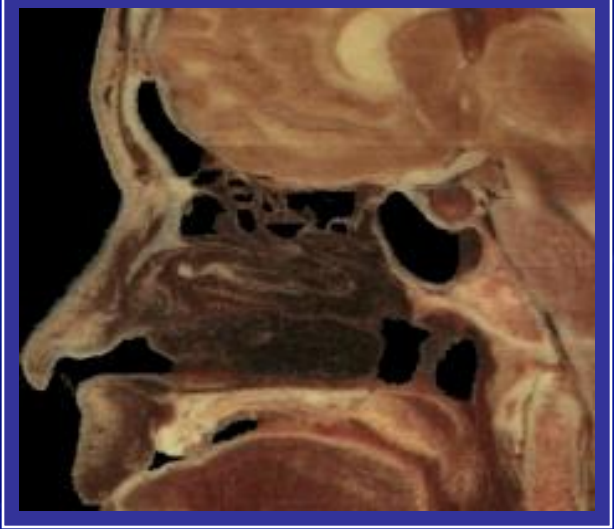
Selective Brain Cooling
"Rhinochill"

Non-invasive
- Intranasal PFC spray delivered through nasal prongs

Can be initiated early
- Ambulance or ED

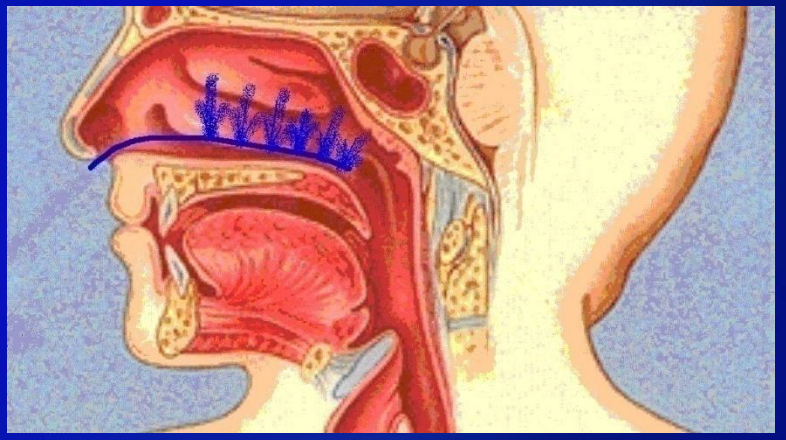
Very rapid cooling
- Upper airways designed for heat exchange

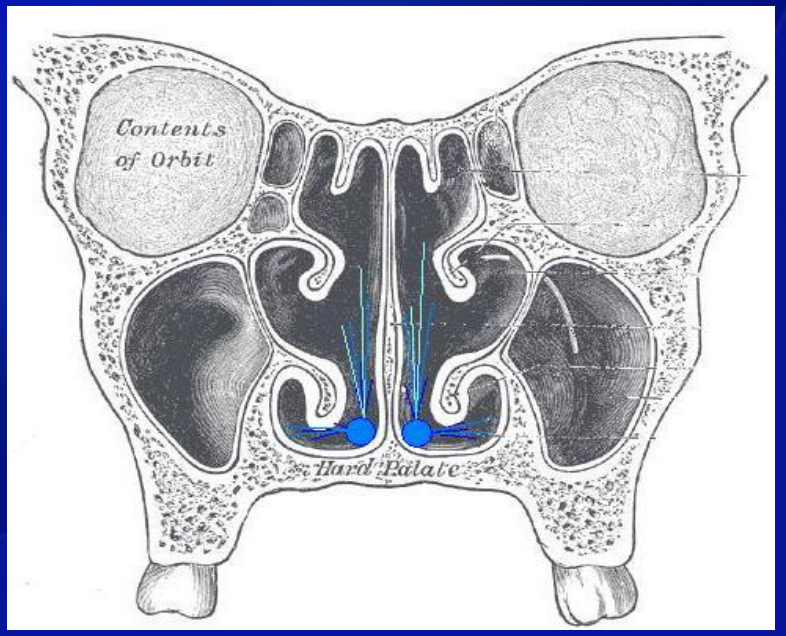
"Preferential" brain cooling
- Brain-core gradient



Physiological Effects

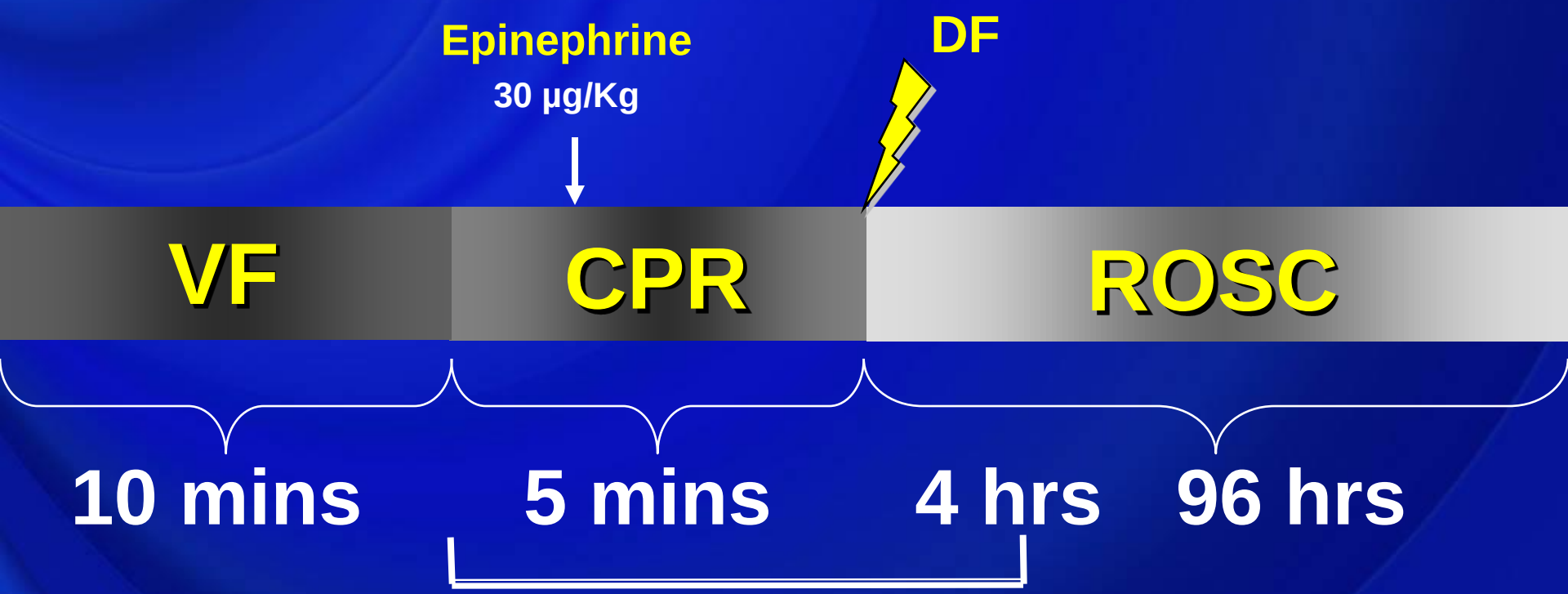
- Perfluorocarbon coolant is sprayed into nasal cavity
- Low surface tension enables wide dispersion
- O_2 facilitates evaporation through which heat is lost
- Heat is lost through the floor of the brain (conductive)
- Heat is lost through local blood vessels (hematogenic)
- Intranasal temperature ≈2°C





Intranasal Cooling Pig VF Study

Guan J, Tang W, et al. Circulation 2007; 116:II-529



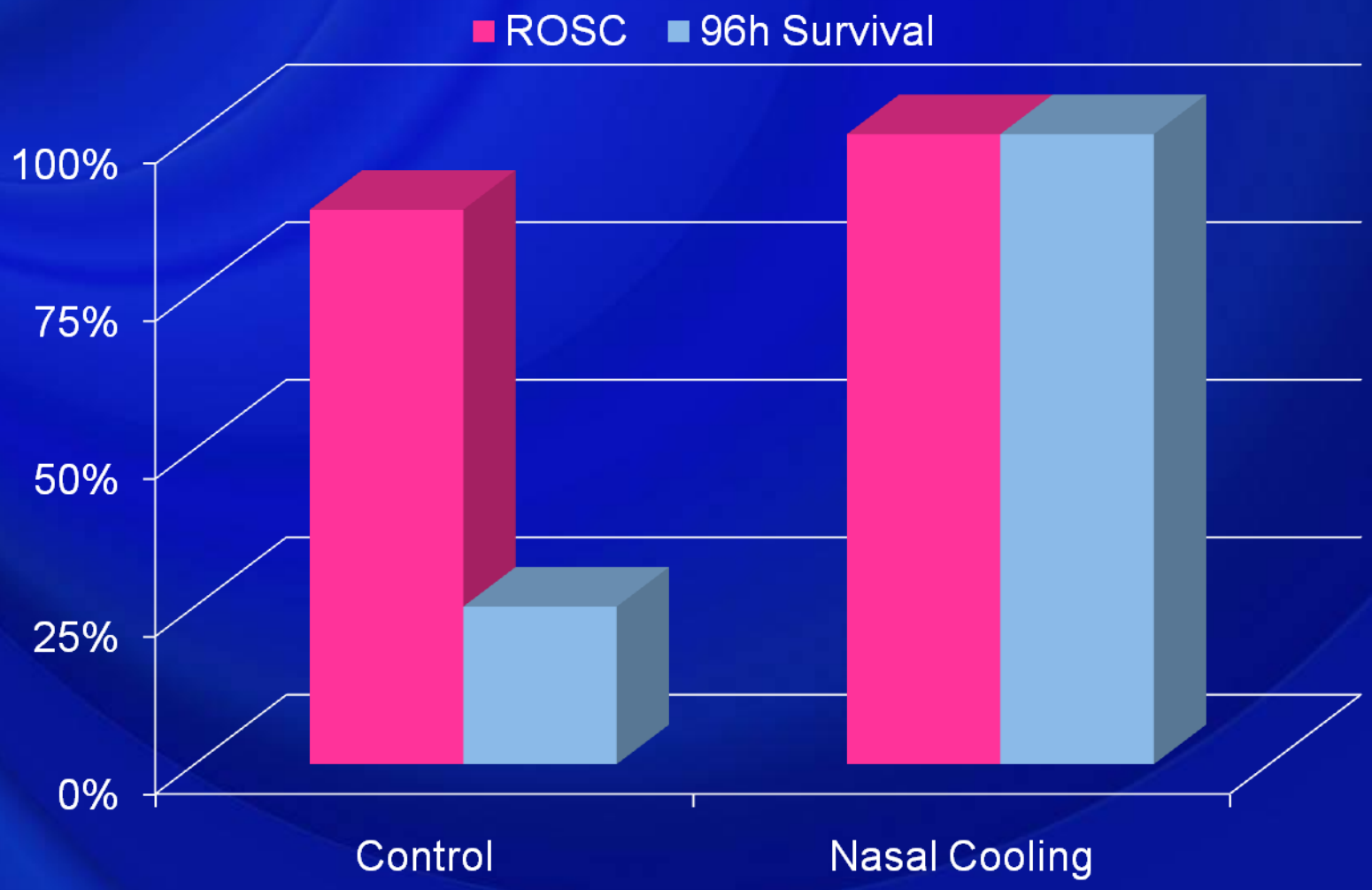
Cooled group

Intranasal cooling until a target core temperature of 34ºC or 4 hrs, whichever came first

Resuscitation Events

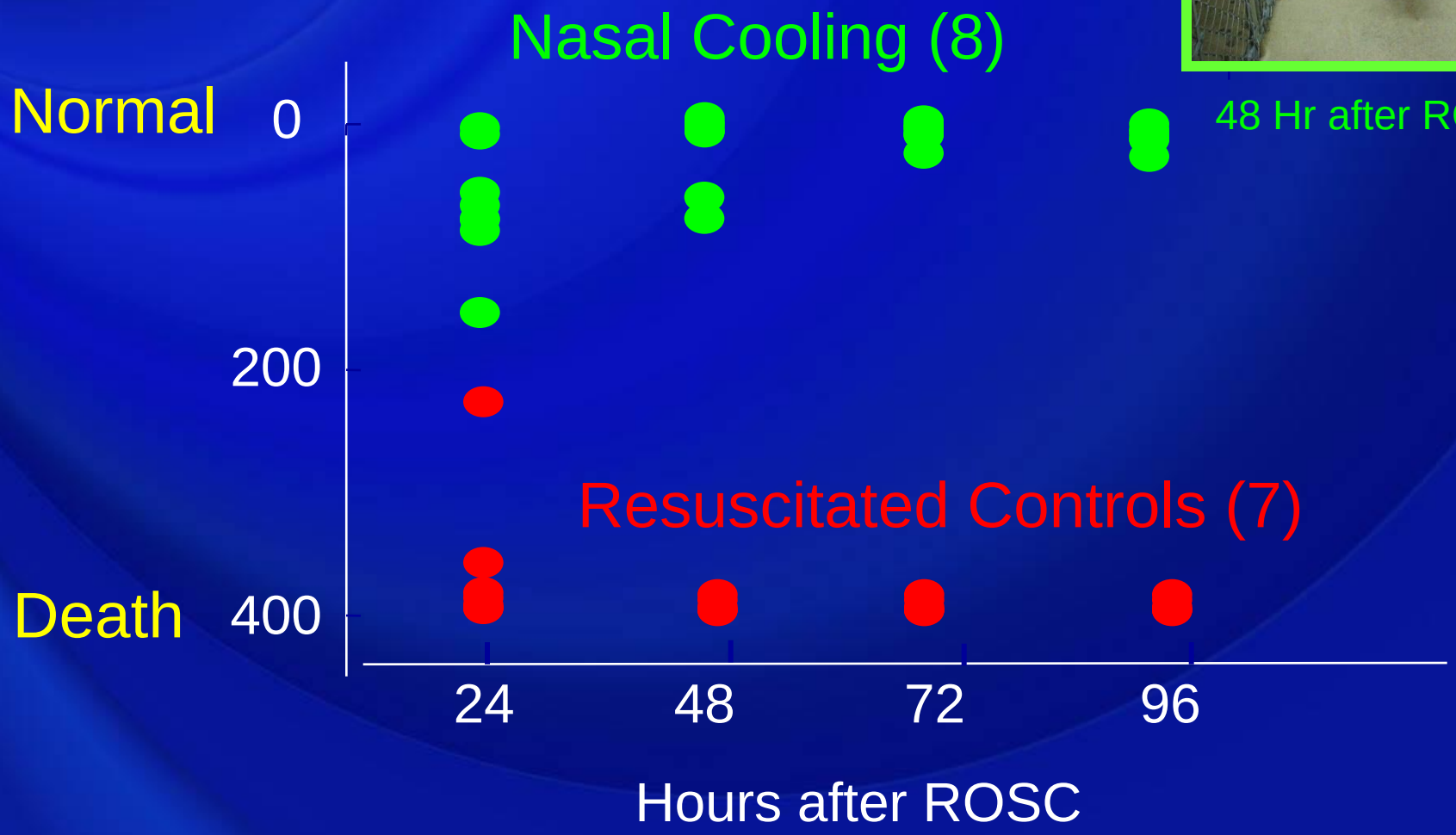
	Control	Cooled	
	N=8	N=8	P
Weight (kg)	40.8±1.9	40.4±.0.7	0.613
CPP before initial electric shock (mm Hg)	17.7±5.6	21.3±9.6	0. 370
No. of electric shock	**14.6±8.6**	**8.1±4.6**	**0.08**
Initial electric shock success (%)	38%	75%	0.315
Total electric shock success (%)	66±19%	88±18%	**0.034**
CPR duration (sec)	**612.9±227.3**	**364.6±42.4**	**0.009**
Epinephrine dosage (μg/kg)	**60±32.1**	**30±0**	**0.01**
ROSC	7(88%)	8(100%)	1

ROSC and Survival



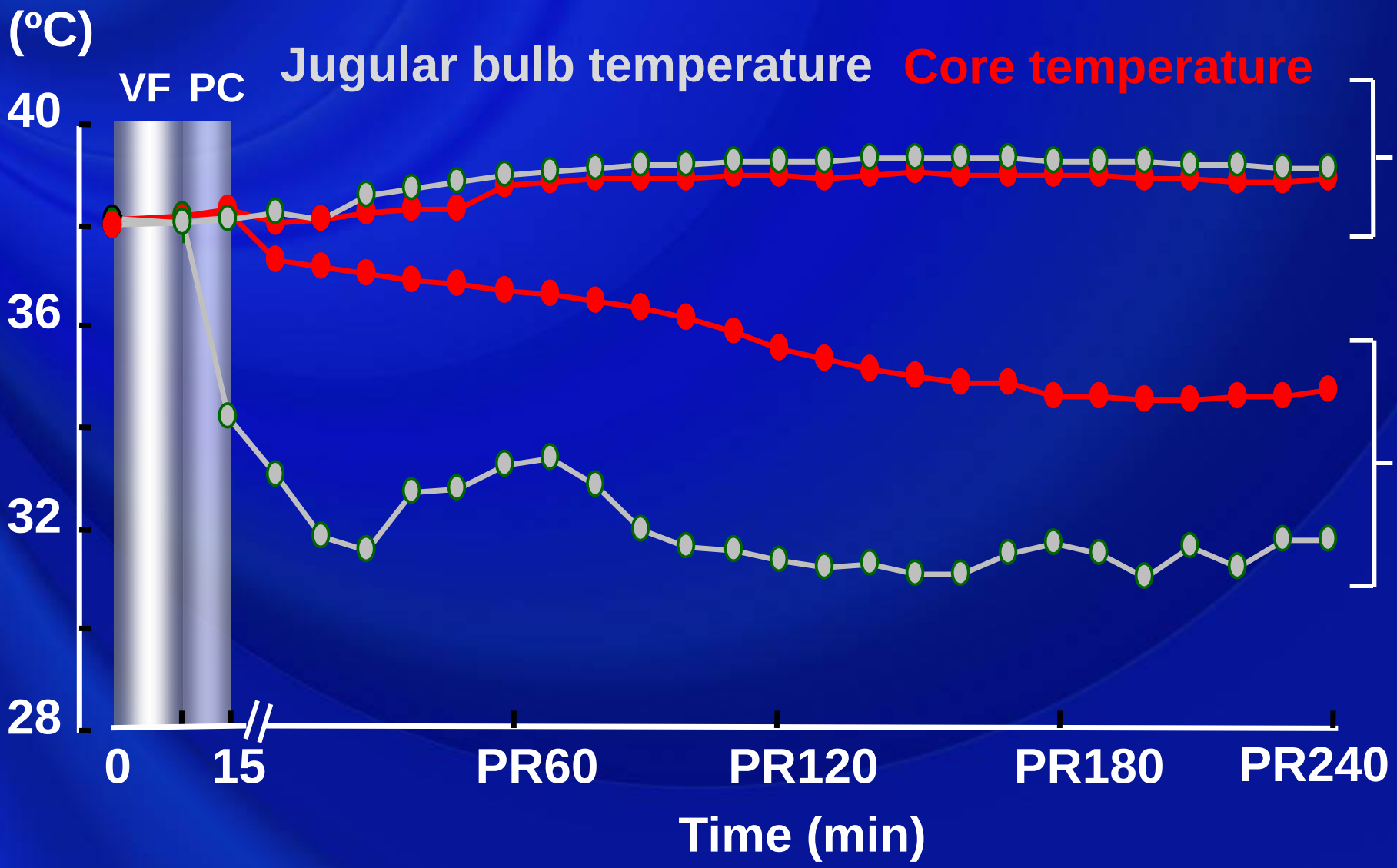
Neurological Deficit Scores

48 Hr after ROSC



Resuscitation Care

Temperature



Induced Therapeutic Hypothermia in Resuscitated Cardiac Arrest Patients

NAEMSP Position Statement

1. Induced hypothermia in the post-resuscitative period has been shown to benefit select survivors of cardiac arrest. Whether induced hypothermia benefits extend to all cardiac arrest patients and what the most effective means and time of initiation of this modality is unknown. A lack of evidence on induced hypothermia in the prehospital setting currently precludes it from any standard recommended use.
2. Efforts should first be expended to maximize the quality provision of other proven resuscitation modalities including high quality, effective CPR and appropriate early defibrillation as well as attentive post-resuscitation monitoring and support.
3. It is important that further research be done to demonstrate ideal time of induced hypothermia, type of patient likely to benefit, and practical, effective means of cooling.
4. Any implementation of pre-hospital cooling must be done in conjunction with a hospital program that will continue the treatment.