Fever Management in the ICU with Cryo
An Introduction to the “Bridge to TTM”
The Cryo Product line
“The Bridge to TTM”

Prehospital / ED

- Losing oxygenated blood to the brain causes neurological injury. **Cryo is a simple and cost-effective method to initiate cooling**
- Seconds to initiate. By anyone, anytime, and anywhere
- No adverse effects
- Available in C-Collar or Wrap configuration

Fever Management

- Large addressable market in ICU
- **Effective fever reduction method**
- Can be used in adjunct with Tylenol
- Often replaces TTM systems below

Targeted Temperature Management
Cost-Savings in the ICU

“With just a few trial uses of Cryo Cooling packs in April 2016, we saved $5400 in our ICU by avoiding the cost of Artic Sun. Cryo is an ideal solution for episodic fevers in our neuro ICU patients, especially for sub arachnoid hemorrhage and intra-cranial hemorrhage patients.”

5/5/16

Debra E. Roberts, MD, PhD
Director, NeuroMedical ICU
Assistant Professor of Neurology, Neurosurgery and Medicine
University of Rochester Medical Center
Rochester, New York
“Other benefits of the cryopacks we found were ease of deployment – nursing loves them. They are **effective at fever reduction** in patients with intermittent fever and save on need for definitive cooling techniques like Arctic Sun. Also, the **patients do not shiver**, which is a major problem with some of the temperature management devices available. This not only **saves us on the cost of the cooling device but also on the multiple medications** that are no longer needed for shiver control. An added bonus is that the **patient does not require deep sedation** and the neuro exam can be followed more easily.”

6/20/16

**Debra E. Roberts, MD, PhD**
Director, NeuroMedical ICU
Assistant Professor of Neurology, Neurosurgery and Medicine
University of Rochester Medical Center
Rochester, New York
Simple
• 10 Seconds to deploy

Fast Cooling
• Cools carotid triangle

Proven
• Avg. 1.7 °C temp drop
• Same as iced saline

Cost-Effective
• As low as $.50 per minute

Safe
• Zero reported complications

Cryo Cooling Element:
- No skin irritation
- Element is -5.0 °C in seconds
- 20-30 minutes below 0 °C
- 15 °C colder vs. standard packs
Cryo Mechanism of Action

- Cryothermic Cooling Pack contacts both carotid arteries and internal jugular veins
- Every 3.5 minutes entire blood supply is cooled noninvasively!

The Human BRAIN:
- 2.5% of the body's weight
- Uses 25% of the body's total oxygen
- Uses 20% of cardiac output
Not all Cooling packs are Created Equal
Cryo Cooling Element

Room Temperature Conclusions:
• Cryo is 15 °C colder (-5 °C ) than standard ice packs
• Cryo absorbs 42 kJ (1 kJ = 1000 Joules) of energy whereas the competitor water/urea pack only absorbs 15 kJ of energy

Cold storage (2 °C/36 °F ) Conclusions:
• Cryo reaches -12 °C/10 °F
• Cryo absorbs 58 kJ of energy. This is a 40% enhancement in energetics.
Published Evidence - Cryothermic Cooling System

- Average temperature drop of **1.7°C in 31 minutes**\(^1\)
  - Tympanic temperature in healthy volunteers (University Hospitals, Cleveland, OH)

- Average temperature drop of **1.3°C in 45 minutes**\(^2\)
  - Esophageal temperature in cardiac transport patients *already cooled* via chilled saline. Goal was not to rewarm. (VitaLink/AirLink Critical Care Transport, New Hanover, NC)

- Equal temperature drop to Chilled Saline - **1.5°C for Cryothermic vs. 1.4°C for Chilled Saline**\(^3\)
  - Tympanic temperature drop in prehospital SCA patients (Prague, CZ)

References:
1. Cerebral Cooling Effectively Achieves Mild Therapeutic Hypothermia in Healthy Volunteers White, et. al., July 2013 [Link]
2. Maintenance of Therapeutic Hypothermia During Critical Care Interfacility Transport Collopy, et al, September 2014, Poster at the Air Medical Transport Conference. [Link]
Entering the Hospital (October 14, 2016)

Cryo Wrap opened up hospital applications

- Bridge to TTM
- FEVER!
Temperature Management in the ICU

Fever avoidance in brain-injured patients:

- Intermittent Neurogenic Fever occurs >70% in:
  - Subarachnoid hemorrhage
  - Stroke
  - Intracranial Hemorrhage
  - Subdural or Epidural Hematoma
  - Refractory intracranial hypertension
  - Drug overdoses
Scope of the Fever Problem
Neuro ICU Fever is Common

Ischemic events with fever above 38.5° C¹
- Cardiac Arrest: 83%
- Subarachnoid Hemorrhage: 73%
- Intracerebral Hemorrhage: 91%
- Traumatic Brain Injury: 68%
- Ischemic Stroke: 61%

Fever is Harmful
- Elevated Body Temperature Independently Contributes to Increased Length of Stay¹
- Temperature elevations after brain ischemia increases degree of injury
- Fever is associated with increased mortality and worsened outcomes
- 1 degree of temperature increase raises the risk of poor outcome by 2.2 times²
- Mortality rate of stroke patients studied at 3 months was 1% in normothermic versus 16% in hyperthermic group³

¹ Diringer, et al., Critical Care Medicine 32:1489, 2004
² Henker, Brown, Marion; Neurosurgery 42:1071, 1998
Neuro Applications

Intermittent Neurogenic fevers

- 70% of brain injured patients spike fever within ICU stay
- 70% of fevers last < 3 hours
- Cryo is ideal for onset of fever and adjunct to Tylenol or TTM Systems
  - Adjunct or prior to Tylenol in first 2 hours of Fever
  - Adjunct to TTM Systems (less costly disposable rather than Artic Sun)
  - “Bridge to Imaging” – Cryo for CT scans - disconnected from TTM Systems
Economic Impact of Fever

- Fever is detrimental in the setting of acute neurologic insults
- Approximately 70% of Neurologic Intensive Care patients develop fever

### Fever Level | Increased # days in ICU
---|---
High (>39.6°C) | 10 days
Medium (38.5-39.5°C) | 5.5 days
Low (to 38.5°C) | 1.7 days

- Fever added an average $17,270 in additional hospital costs

Published, *Journal of Intensive Care Medicine*, Reaven et al., April 2009
Effects of Temperature Spikes

“For every 1°C above 37°C in mean daily-maximum temperature, the odds increased:

• 9-fold for death
• 3-fold for death or moderate-to-severe disability
• 2.5-fold for dependence in activities of daily living, and
• 2.5-fold for cognitive impairment.

For every 1°C above 38.3°C (conventional definition of fever), the odds for poor outcomes increased even further:

• 22-fold for death
• 7-fold for death or moderate-to-severe disability
• 9-fold for dependence in activities of daily living, and
• 7-fold for cognitive impairment.

Most patients (72%) developed at least one temperature elevation of greater than 38.3°C.


Josh Levine Study, University of Pennsylvania
Brain waves recorded on EEG slow with brain fever.

Notice **fever spike** correlates to a **slowing in brain** activity recorded by EEG. Faster brain activity returns once fever is controlled. Slow brain activity is associated with dysfunction in gray matter cortex, such as ischemia.

Chart courtesy Brandon Foreman, MD; University of Cincinnati, Department of Neurology & Rehabilitation Medicine, Division of Neurocritical Care.
Bridge to Imaging Case Study in the ICU

Cryo Cooling Elements may be used as a “Bridge to Imaging” when patients are disconnected from TTM systems to avoid Fever Spikes.

**Case Study:** Artic Sun patient takes 5+ hours to regain normothermia for CT scan.
Cryo Summary – “The Bridge to TTM”

- Simple
- Proven
- Cost-effective

Thank you.

Published clinical data can be found at www.cryothermicsystems.com

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