Pre-clinical demonstration of a portable intranasal brain cooling device for rapid traumatic brain injury treatment

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Background

- Targeted brain cooling can prevent encephalopathy during traumatic brain injury (TBI) when blood oxygen availability is low, swelling is prevalent, and intracranial pressure is high
- **Intranasal cooling**: a minimally invasive technique to reduce brain temperature
- Cooling needs to begin within 90 minutes of injury – impossible in the field considering current devices

Approach

ICEPICC (Intranasal Cooling for Encephalopathy Prevention in Combat Casualties): a portable system for providing cooled airflow to lower brain temperature to normothermic and therapeutic hypothermic ranges.

Figure 1: ICEPICC system with tympanic membrane temperature probe and cannula connection.

Methods

As part of preclinical experimentation, ICEPICC was tested in an animal (porcine) model.

1. Pigs were intubated and instrumented.
2. Baseline temperatures and relevant physiological parameters were recorded prior to initiating cooling, and continuously throughout the experiment.
3. Cooling was initiated for a period of 4 hours – air temperature 5-10° C, flow rate 25 L/min.
4. Cooling was halted and rewarming was initiated until the pigs returned to baseline brain temperature.

Effects on porcine model

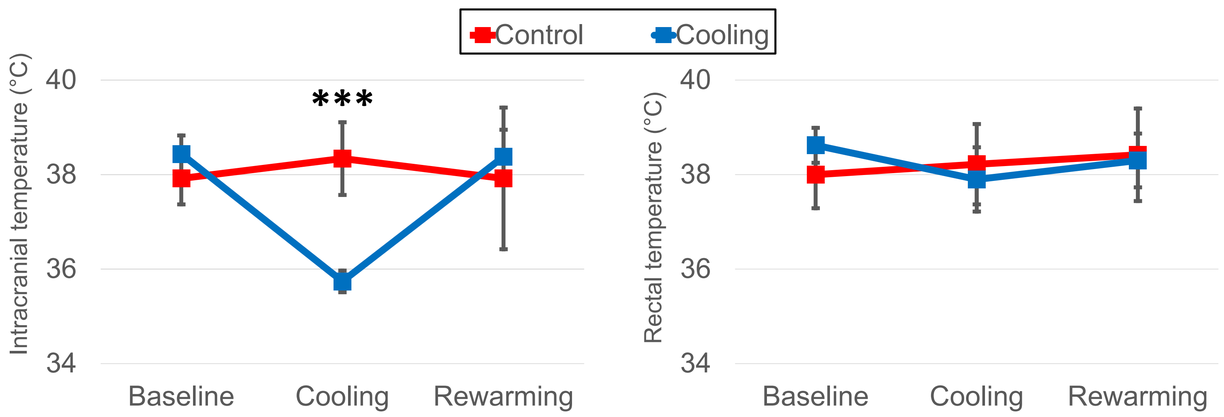

Figure 2: Recordings of intracranial (left) vs. rectal (right) temperature throughout cooling and rewarming process. Mean (n = 5) ± SD; ***: $p < 0.001$

- Cooling was rapid, with 50% (1.4°C) of total temperature change within 14 minutes.
- Histological analysis showed acceptable damage to the nasal cavity and brain tissue.

Conclusions and future directions

This animal study demonstrate the safety and effectiveness of targeted brain cooling in a healthy porcine model.

Next steps:

- Evaluating the device in humans in a hospital setting (Pilot Study)
- Developing a platform to provide treatment to combat casualties, prevent encephalopathy, and significantly reduce the risk of permanent neurological damage for military members

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