A Novel Nasopharyngeal Method for Rapid Selective Brain Cooling

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Motivation

- Cooling reduces brain damage and mortality following cardiac arrest, TBI, stroke, and birth asphyxia
  - Health care $ saved – 15 billions per year
- Whole body cooling (WBC)
  - Cooling blankets or wraps
  - Cold water bath
  - Endovascular cooling catheter
- Side effects of WBC
  - Shivering
  - Myocardial ischemia
  - Arrhythmia
  - Coagulopathy
Selective Brain Cooling

- Localized cooling of the head
  - Hoods/caps with circulating cold air or water
  - Ice packs or gels

- Cooling the upper airways
  - Spraying coolant (Per-fluorohexane) into nasal cavities
  - Nasopharyngeal balloon with circulating cold water
Selective Brain Cooling

- Why cooling nasal cavities works
  - Nasal anatomy
Selective Brain Cooling

- Methods for cooling nasal cavities
  - Spray coolant at high flow rate (25 L/min) into nostrils
    - Perfluorohexane
      - Green house gas
      - Not readily available, expensive
  - Insertion of cooling balloons into nostrils
    - Invasive
      - Risk of injury, uncomfortable
      - Source of cold water/fluid
  - Blowing cold air into nostrils
    - Easily available source of cold air??
Selective Brain Cooling

- Ranque-Hilsch (Vortex) tube
  - Works with compressed air
  - No electricity or chemical required
  - Compact in size (dia 44 mm; length 270 mm)
Pre-Clinical Testing in Rabbits

- Temperature probes implanted into the brain and rectum
Pre-Clinical Testing in Rabbits - Results

- Six rabbits
- Brain cooled to 32-34°C in less than 50 min
- Whole body remained > 36°C – shivering threshold
Selective Brain Cooling with Vortex Tube

- A convenient method for cooling the brain
  - Reaches therapeutic range within 30 minutes
  - Maintain whole body temperature above shivering threshold
  - Minimize side-effects of cooling
- Inexpensive
  - Uses compressed air vs perfluorohexane
- Easily accessible
  - In-hospital – existing compressed air supply
  - Out-of-hospital
    - compressed air cylinder – 30 minutes
    - Ambulances
    - Public places – malls, schools, parks
Selective Brain Cooling – Clinical Prototype

- **Nose Pillow**
- **Cold Air**
- **Servo-controller**
- **Tympanic thermometer**
Selective Brain Cooling

- Patent application
  - PCT/CA2015/050516

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Selective Brain Cooling

Thank you!

Questions?

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