In Vivo Feasibility of Catheter Based Selective Profound Cerebral Hypothermia

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Background: Mild hypothermia has been shown to improve outcome in comatose survivors after resuscitation from out-of-hospital cardiac arrest. It has been suggested that induction of deep hypothermia before reperfusion may further improve outcome. Current techniques involve total body cooling, with the limitations of rapidity and depth of cooling due to systemic adverse effects. We studied a novel catheter-based system designed to rapidly and selectively cool the brain while maintaining systemic temperature within normal range. The unique design incorporates a counter current flow to insulate the normothermic systemic blood from the cooled blood perfusing the brain. **Methods**: A transfemoral approach was employed in 12 swine (65-72kg). Using standard radiological techniques, the multilumen catheter was positioned to isolate the common carotid artery. Blood was withdrawn from the aorta via one lumen, cooled extra corporeally, and reperfused through a second lumen into the carotid artery. Outflow blood was cooled to 5-20°C, and reperfused at rates of 80-250 ml/min for 30-180 minutes. Temperature was measured in bilateral frontal lobes, nasopharynx, ear, esophagus and descending aorta.
Results: Unilateral hemicranial and hemicerebral cooling to 15°C was achieved. Only limited associated systemic cooling was noted. Initial cooling rates of 1.8°C/min were attained, and were dependant on inflow rate and temperature. No adverse events occurred. Contralateral hemispheric cerebral temperature closely followed systemic temperature. Passive rewarming did not result in rebound hyperthermia.
Conclusion: This new catheter-based system demonstrated feasibility in providing rapid, selective deep cerebral hypothermia, and may offer an improved method for neuroprotection during cardiac arrest and other ischemic injury.