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Effective Stable Isolated Moderate Bilateral Cerebral Hypothermia Achieved with an Intravascular Approach

Meerkin, D[1]; McKemie, S[1]; Lieber, G[2]; Solar, R[2]
[1]Shaare Zedek Medical Center, Jerusalem, Israel; [2]ThermopeutiX Inc, San Diego, USA

Background: The neuroprotective effects of mild hypothermia following cardiac arrest have been clearly established. Limitations in clinical practice include rapidity in achieving target temperature and adverse cardiac effects <32°C. We assessed the ability of a self-insulating cooling system to achieve rapid isolated moderate (28-30°C) bilateral cerebral hypothermia. Methods: From the femoral artery, a catheter-in-catheter system was positioned with the inner lumen in a single common carotid artery and the outer lumen in the aortic arch in 9 pigs (60-64kg). Blood from the aorta, was cooled and reperfused into the carotid artery using a dialysis machine. Initial pump flow rates were 100cc/min and modified in accordance with target temperature. Warming blankets were placed beneath all animals. In 4/9, warming blankets were placed both above and below the animals. Thermistors were placed at a depth of 1-1.5 cm in each cerebral hemisphere, and a rectal probe was used for systemic temperature. Cooling was performed for 3 hrs, with a target ipsilateral temperature of 28-30°C. Results: The catheter was successfully deployed in all animals. Target temperatures of <30°C in both cerebral hemispheres was achieved in all animals. Time to target temperature (<30°C) was 31±13 and 44±18 mins in the ipsilateral and contralateral cerebral hemispheres respectively. An ipsilateral hemispheric temperature of <34°C was achieved in 4/9, 8/9 and 9/9 animals within 5, 15 and 30 mins respectively. Pump flow rates were 89±49 cc/min (range 50-250 cc/min). Contralateral hemispheric temperature reached equivalence to the treated side within 60 mins in 8/9 cases. Systemic temperatures fell by 3.9±1.9°C to 34±1.6°C. In the 4 animals that were more aggressively heated, systemic temperatures fell by only 2.0±1.0°C, to 35.5± 0.9°C. Conclusions: Isolated moderate cerebral hypothermia was rapidly achieved and maintained with a novel self insulating catheter system at low flow rates.