Intranasal Spray of Perfluorocarbon Can Rapidly Reduce Brain Temperature and Culminate In Systemic Hypothermia In a Pig Model of Prolonged Cardiac Arrest

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Introduction: Current international guidelines recommend mild hypothermia for unconscious patients following resuscitation from cardiac arrest, with the emphasis of implementation as early as possible.[1,2] However, current methods of inducing hypothermia are (1) invasive, (2) slow to reach target temperature, (3) difficult for field use, and (4) prone to have the potential of overshooting body temperature.[3] Based on anatomical features, cooling into the nasopharynx may offer the capability to cool the brain directly through conduction and indirectly through circulation and finally cool the whole body through circulation.[4,5] We address the option of nasopharynx cooling by intranasal spray of evaporative perfluorocarbon driven by compressed oxygen. Our hypothesis was that cooling in the nasopharynx by spraying of evaporative perfluorocarbon could rapidly reduce brain temperature and culminate in systemic hypothermia in a pig model of prolonged cardiac arrest.

Methods: Ventricular fibrillation was electrically induced in 4 male domestic pigs and untreated for 10 minutes. After 5 minutes of cardiopulmonary resuscitation (CPR), defibrillations and additional CPR were attempted until return of spontaneous circulation (ROSC). In 2 hypothermia animals, continuous transnasal spray of evaporative perfluorocarbon (Fig 1) was started coincidently with mechanical CPR and continued until pulmonary artery temperature measured in the pulmonary artery was reduced to 34°C. The spray was then adjusted to maintain blood temperature between 34°C and 34.5°C until 4 hours after ROSC. Brain temperature was directly measured by needle sensor inserted into cerebral parenchyma (Fig 2) and recorded with blood temperature over an 8-hour interval after ROSC.

Results: After ROSC, brain and blood temperature could be reduced rapidly at a rate of 1.7°C/hr and 1.2°C/hr, respectively in hypothermia animals, but increased 0.7°C and 0.8°C, respectively at 4 hours after resuscitation in control animals. Even after another 4 hours of passive rewarming, both brain and blood temperature in hypothermia animals were 3.6°C lower than those in control animals (Fig 3).

Conclusion: Intranasal spray of perfluorocarbon could rapidly reduce brain temperature and culminate in systemic hypothermia in this pig model of prolonged cardiac arrest.

References:

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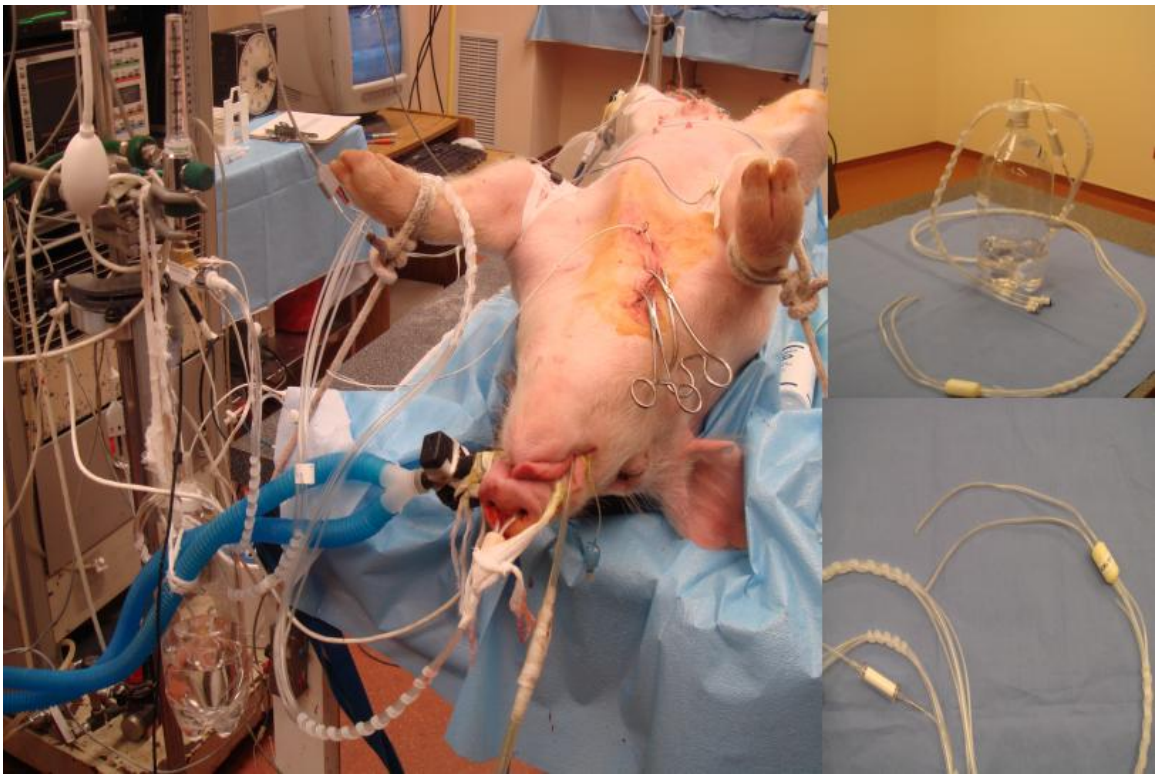

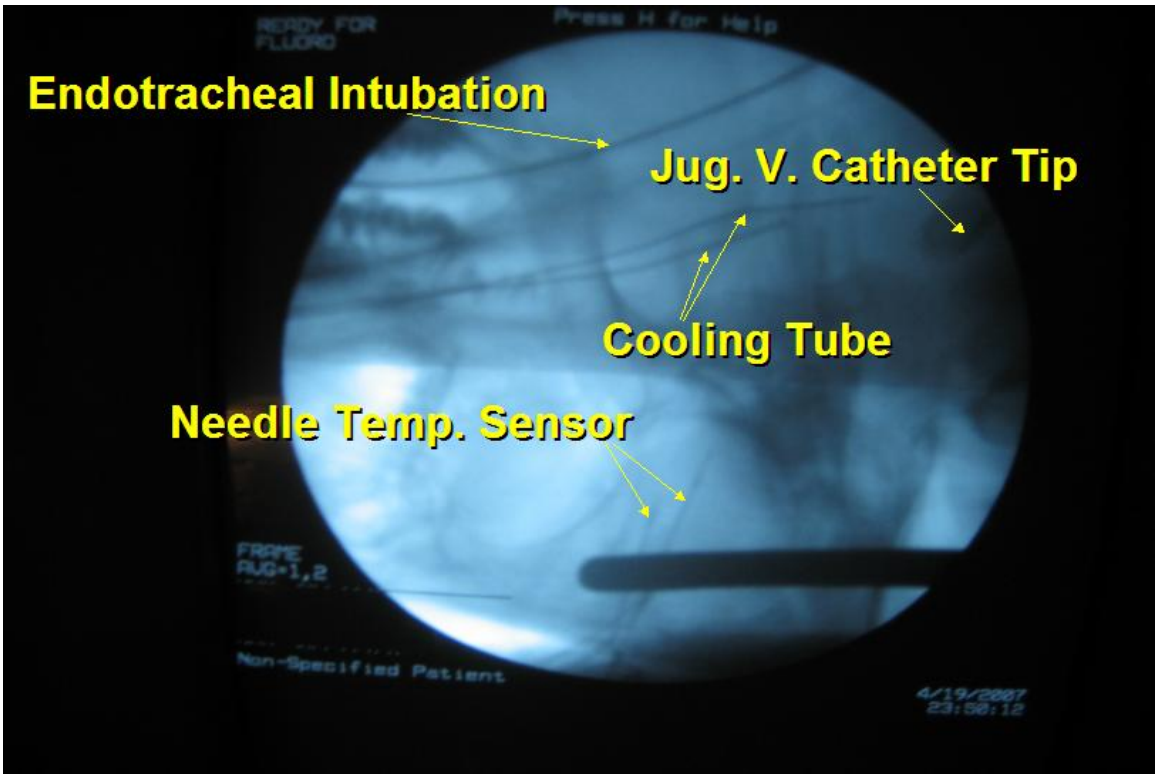
READY FOR FLUORO
Press H for Help
Endotracheal Intubation
Jug. V. Catheter Tip
Cooling Tube
Needle Temp. Sensor
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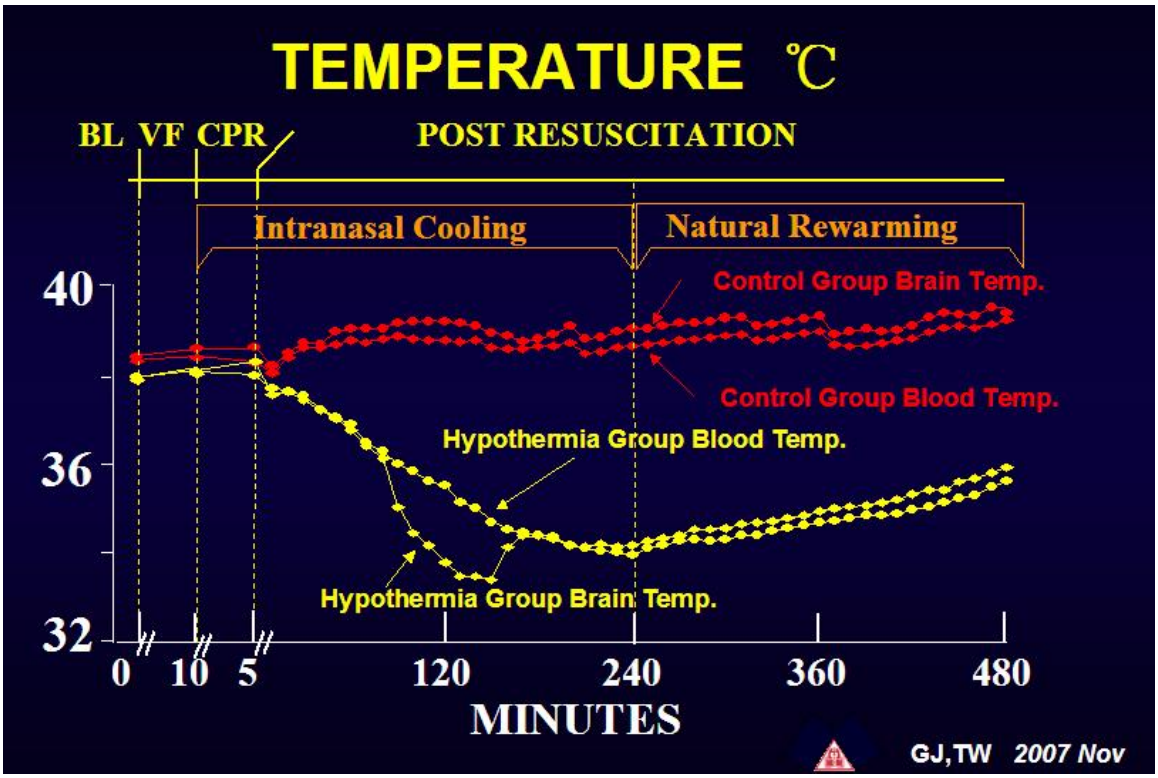
TEMPERATURE ℃
BL VF CPR
POST RESUSCITATION
Intranasal Cooling
Natural Rewarming
Control Group Brain Temp.
Control Group Blood Temp.
Hypothermia Group Blood Temp.
Hypothermia Group Brain Temp.
40
36
32
0 10 5 120 240 360 480
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