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Surrogate Temperature Measurements during Selective Cerebral Hypothermia

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Background: The neuroprotective effects of mild systemic hypothermia (SH) post cardiac arrest are well established. Improved effects of moderate and profound hypothermia have been demonstrated in arrest and stroke models. Cardiac adverse effects limit SH to 32°C. Recently, attempts have been made to develop techniques of selective cerebral hypothermia (CH) where moderate CH is achieved in the presence of limited SH. Transfer of these techniques to human trials is partially limited by the inability to determine the degree of the CH in the absence of intracranial thermistors. Our aim was to determine the ability of surrogate measures to accurately represent intracerebral temperatures.
Methods: Using a transfemoral arterial approach, 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.
Temperatures were measured with thermistors placed at a depth of 1-1.5cm in each cerebral hemisphere. Cooling was performed for 3hrs, with a target ipsilateral cerebral temperature of 28-30°C. Additional thermistors were positioned in the rectum, esophagus, right and left nostrils and introduced cranially in the right and left jugular veins (JV).
Results: The mean treated cerebral hemisphere reached target temperature in 15 mins. The ipsilateral JV temperature responded most rapidly with a gradient of 2°C over the first hour. At 90 mins there was equilibration with cerebral temperature. Nasal temperature remained consistently 1-2°C higher. On the contralateral side, a consistent 1-2°C gradient was noted over 180 mins with both nasal and JV temperatures.
Conclusion: In this selective cerebral hypothermia model, jugular venous temperature most closely represents true intracerebral temperatures with regard to response time and steady state gradient.