

Selective head cooling initiated during CPR induces post-resuscitation carotid artery dilation and increases in carotid artery flow and cerebral cortical microcirculation

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Introduction. We have previously reported that selective head cooling initiated during CPR prevented increases in brain temperature and improved neurological outcome. In the present study, we explored the relationship between head cooling during CPR and cerebral blood flows. We hypothesized that head cooling during CPR would yield carotid artery dilation with consequent increases in carotid flows and cerebral cortical microcirculation.

Methods. Eight pigs weighing 37 ± 1 kg were intubated and mechanically ventilated. The common carotid artery was isolated and a parietal craniotomy was created. Ventricular fibrillation was electrically induced and untreated for 4 min. Animals were then randomized to head cooling or control. Head cooling was initiated with the aid of the RinoChill device (BeneChill Inc) at the beginning of CPR. CPR was performed for 4 min prior to defibrillation. Common carotid artery diameter and flow were assessed with a Doppler transducer. Cerebral cortical capillary density, representing the number of perfused capillaries, was assessed with Sidestream Dark Field imaging (MicroVisionMedical Inc). Brain temperature was measured with a needle sensor inserted in the cerebral cortex.

Results. All the animals were resuscitated. After resuscitation, the brain temperature was significantly decreased in animals subjected to head cooling. Significantly greater carotid artery diameters and flows were observed in animals subjected to selective head cooling compared to the control animals. These increases in carotid blood flows were accompanied by significantly greater numbers of perfused capillaries in the cerebral cortices. No differences in cardiac output were observed between the two groups (Table).

Conclusion. Early selective head cooling induces carotid artery dilation and increases in carotid flows and cerebral cortical microcirculation after resuscitation.

	Head Cooling	Control	p value
Brain Temperature, °C			
BL	38.1 ± 0.5	37.8 ± 0.6	NS
PR 2 min	36.8 ± 0.4	37.6 ± 0.4	< 0.05
PR 5 min	36.7 ± 0.1	37.6 ± 0.4	< 0.01
PR 10 min	36.5 ± 0.3	37.6 ± 0.4	0.01
Carotid Diameter, cm			
BL	0.39 ± 0.05	0.38 ± 0.07	NS
PR 2 min	0.46 ± 0.07	0.34 ± 0.04	< 0.02
PR 5 min	0.45 ± 0.07	0.32 ± 0.05	< 0.02
PR 10 min	0.44 ± 0.09	0.34 ± 0.04	< 0.05
Carotid Flow, mL/min			
BL	315 ± 65	291 ± 64	NS
PR 2 min	576 ± 93	321 ± 71	< 0.01
PR 5 min	563 ± 130	315 ± 63	< 0.01
PR 10 min	482 ± 38	257 ± 86	< 0.01
Cortical Capillary Density			
BL	31 ± 1.7	32 ± 2.5	NS
PR 2 min	81.3 ± 7.2	38.7 ± 6.1	< 0.01
PR 5 min	62 ± 4.6	39 ± 4.6	< 0.01
PR 10 min	62.3 ± 7.1	36.3 ± 9.8	< 0.02
Cardiac Output, L/min			
BL	6.6 ± 0.6	6.3 ± 0.7	NS
PR 5 min	7.3 ± 1.6	7.9 ± 2.6	NS

BL = baseline; PR = post resuscitation.