A Comparison Between Head Cooling Begun During CPR and Surface Cooling after Resuscitation

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Introduction: Mild systemic hypothermia initiated after return of spontaneous circulation (ROSC) improves outcomes.[1] When cooling is initiated prior to ROSC, there is the possibility that initial resuscitation and ROSC are compromised. Employing transnasal head cooling in a pig model of prolonged ventricular fibrillation (VF), we hypothesized that beginning head cooling during cardiopulmonary resuscitation (CPR) would compare favorably with conventional systemic hypothermia induced by surface cooling which is started at 2 hours after resuscitation from VF.

Methods: VF, induced in 8 male pigs, remained untreated for 10 minutes. After 5 minutes of CPR, defibrillations with a biphasic 150 J shock and additional CPR were attempted. Hypothermia was started coincidently with CPR with continuous intranasal spray of evaporative perfluorocarbon and continued until the blood temperature in the pulmonary artery (T_{blood}) was reduced to 34 ℃. T_{blood} was then maintained between 34℃ and 34.5℃ until 4 hours after ROSC. Surface cooling (n=8) with a cooling blanket was started, in accord with current clinical practices, at 2 hours after ROSC and target temperature was maintained until 10 hours after ROSC. In 8 control animals, methods were identical except for neither head nor surface cooling. T_{blood} and retrograde right jugular vein temperature (T_{jv}) were recorded. Survival and Neurological Deficit Score[2] (NDS) were recorded over a 96-hour interval after ROSC.

Results: Baseline blood temperature was 38±0.1 ℃ for each group. All animals were successfully resuscitated excepting one animal in each of the surface cooling and control groups. After 5 minutes of CPR, T_{jv} was 38.3± 0.2 ℃ in the surface cooled animals and 38.1±0.3℃ in control animals, in comparison to 34.2±4.5 ℃ in the head cooled animals ($p<0.01$), as shown in the Figure. However, there were no differences in blood temperatures among the three groups at that time. Nevertheless, both head cooled and surface cooled animals had an improved 96-hour survival, namely, 8/8 and 6/8 vs 2/8, in controls ($p<0.05$). Significantly better neurological outcomes were observed in head cooled animals in comparison with both surface cooled and control animals (Table).

Conclusion: Early head cooling during CPR continuing for 4 hours after resuscitation produced neurological outcomes comparable to those of delayed surface cooling of 8 hours duration.

References:

1. Greer DM. Curr Neurol Neurosci Rep. 2006; 6(6): 518-24.
Berg RA, et al. Crit Care Med. 1994;22(2):282-90.

Neurological Deficit Score[a] after Cooling

Hours Post ROSC	HEAD (8)	SURFACE (7)	CONTROL (7)	p[b]
24	**60 (23, 70)**	**195 (185, 223)**	**400 (288, 400)**	**0.000**
48	**0 (0, 28)**	**95 (65, 100)**	**400 (215, 400)**	**0.005**
72	**0 (0, 0)**	**40 (20, 80)**	**400 (205, 400)**	**0.006**
96	**0 (0, 0)**	**0 (0, 40)**	**400 (205, 400)**	**0.008**

a: Neurological Deficit Score (NDS) 400=death or brain death, 0=normal

b: Overall effect [Kruskal-Wallis Test]

c: NDS expressed as median (quartile1, quartile3)