

COOLING

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Mild to moderate hypothermia (32-33 degrees C.) is an established neuroprotectant in the laboratory, showing remarkable and consistent effects across multiple laboratories and models of brain injury. Since no single pathway can be identified by which hypothermia ameliorates ischemic brain injury, the robust and reproducible effect of hypothermia in different animal models may originate from simultaneous modulation of multiple pathways during the time sensitive pathways during ischemia and reperfusion. At the clinical level, mild hypothermia has shown benefits in patients who have suffered cardiac arrest and in some pediatric populations suffering hypoxic brain insults. Current literature demonstrates that in order to appreciate the maximum benefits of hypothermia, brain-cooling needs to begin soon after the insult, maintained for relatively long period periods of time, and applied in conjunction with the re-establishment of cerebral perfusion. Translating this concept to the clinical arena is challenging, especially rapid cooling and the re-establishment of perfusion. The exquisite time sensitivity of cerebral ischemia, vulnerability of some stroke patients along with the known untoward effects of therapeutic cooling necessitates the evaluation and possibly combination of novel cooling technologies. Local or regional brain cooling can be distinguished from systemic cooling, although over time brain to body temperature gradients will disappear. The concept of preferential brain cooling with helmets, neck collars or nasopharyngeal approaches may aid traditional systemic cooling techniques in providing a "first pass" cooling effect to the target organ - brain. Pharmacological methods to reduce shivering and/or provide cooling must be investigated in the clinical arena; the integration of pre-hospital and hospital emergency services to assess and treat stroke patients to provide therapeutic cooling.

In conclusion, various cooling technologies must be tested for feasibility to provide continuation of therapeutic cooling from the field to the stroke or intensive care unit and safety in the vulnerable stroke patient population. It furthermore must be investigated how the cerebral perfusion can be most effectively re-established in cooled patients and whether combinations of cooling methods (multimodal cooling) provide additional benefit.