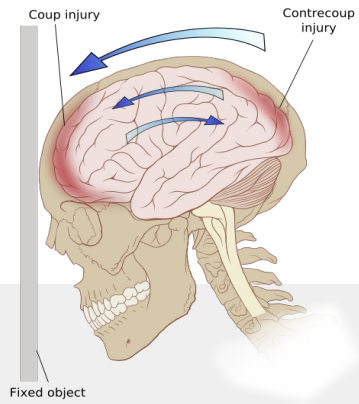
External Brain Cooling via Emissary Capillaries

"Vascular arrangements allowing a bulky transfer of venous blood from the skin of the head to the dura mater provide an excellent anatomical basis for the convection process of brain cooling." *Continued below…*

- Thus, Brain Cooling technology will indeed function as an effective temporary salve to a crash victim pre-A&E admission, as the crash helmet cannot be removed in the field prior to A&E arrival due to the very real danger posed by way of risk of injury to the spinal cord

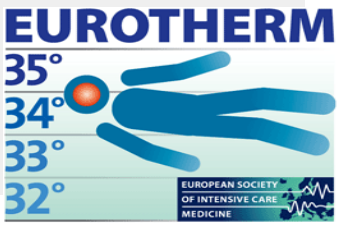


The technology is indeed 'Cutting Edge' by virtue of the fact that the **The Cochrane Collaboration** database wrote:

"Traumatic brain injury (an injury to the brain that occurs as a result of a direct impact, such as may occur after road traffic accidents and falls) is a major cause of death and long-term disability worldwide. There is some evidence from animal experiments that reducing body temperature after brain injury may improve the outcome. There is also some evidence in humans to suggest that people with a normal body temperature after traumatic brain injury may have a better outcome than those with a higher temperature."

However: ***"****Two authors independently searched for relevant trials. We were unable to find any randomised, placebo-controlled trials of modest cooling therapies after traumatic brain injury."*

The Eurotherm3235 Trail is a Europe-wide study to definitively prove the benefits of brain cooling after TBI. Once published next year, Cochrane will update its findings.



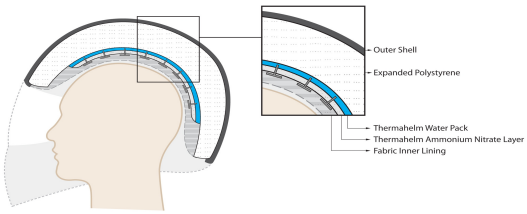
Cont. from above…"The dura mater, with its extraordinarily high vascularization controlled by a potent vasomotor apparatus, may transmit temperature changes to the cerebrospinal fluid (CSF) compartment. Temperature gradients of the CSF may in turn influence the temperature of brain parenchyma (1) directly, along the

extensive contact area between the cerebrocortical surface and the CSF-compartment, or (2) indirectly, via brain arteries that extend over long distances and arborize within the subarachnoid space before entering the pial vascular network and brain parenchyma. ***Numerous subarachnoid and pial arterial branches exposed to the CSF have diameters in the range of the vessels of the retia mirabilia of animals in which selective brain cooling from endothermic application to the cranial dermis has been clearly established experimentally.”***

“It is also shown that the arrangements of venous plexuses within the vertebral canal provide anatomical preconditions for a cooling of the spinal cord via the CSF. The possibility of spinal cord and spinal ganglia cooling by temperature convection via venous blood — cooled in the venous networks of the skin of the backflowing through numerous anastomoses to the external and internal vertebral plexuses and, finally, into the vascular bed of the spinal dura is discussed on the basis of anatomical facts.”

And I quote:

"In both subjects the blood flowed rapidly from skin to brain during hyperthermia; during hypothermia no flow was detected in one subject, and in the other blood flow was clearly reversed." M. Cabanac and H. Brinnel, "Blood flow in the emissary veins of the human head during hyperthermia,"



"Because of its relatively large mass the human brain needs to be cooled more than that of most other species. At rest, this is accomplished by the carotid blood; when the temperature of the artierial blood is raised, the brain is in jeopardy and there is need for a mechanism to cool the brain directly. Caputa et al (1978) have shown that in humans the blood flows in the opthalmic vein according to a pattern compatible with a cooling of the brain during hyperthermia. When the subjects were hypothermic, the blood flowed from brain to dermis, but when they were hyperthermia from demis to brain. Thus cool blood from the sweating skin was directed towards the sinus cavernosus which therefore appears to be a heat exchanger between venous blood cooled by peripheral skin and warm arterial blood. The emissary veins are quite numerous and do not possess valves, and the thermal dependence of the direction of blood flow in them coupled with the earlier results of Caputa et al, on the flow in the ophthalmic vein, give clear indication of a possible mechanism for the cooling of the human brain during hyperthermia." M. Cabanac and H. Brinnel, "Blood flow in the emissary veins of the human head during hyperthermia,"

Eur. J. Applied Physiol. (1985):54:172-176, P. 173, 175