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SELECTIVE BRAIN COOLING IS IMPAIRED IN REM SLEEP

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In mammals, the arterial blood perfusing the brain is primarily cooled through the cool venous blood returning from the systemic heat exchangers of the body (upper airway mucosa, ear pinna, horn, glabrous skin, tail) to the heart (systemic brain cooling).

In some species (e.g., cat, dog, sheep, and goat), there is, in addition, a mechanism for selective brain cooling (Fig. 1) in which the carotid blood supply to the brain is thermally conditioned prior to entering the circle of Willis (6, 11). Countercurrent heat exchange is achieved by a network of fine vessels (the carotid rete) in contact with cranial venous plexuses receiving cool venous blood from the systemic heat exchangers of the head (nasal mucosa, ear pinna, horn). In this selective heat exchanger, heat is transferred from the warmer arterial blood (aortic arch temperature) to the cooler venous blood returning from heat dissipating systemic heat exchangers of the head.

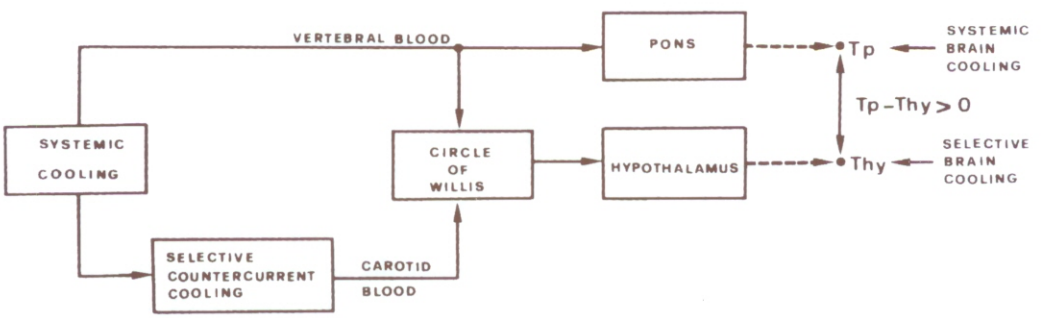

Fig. 1. - *Schematic diagram showing the mechanism of selective brain cooling in the cat, a species which has a carotid rete.*

Only the routes of blood flow thermally relating systemic and selective heat exchangers with the encephalon are indicated. Vertebral arterial blood is warmer than the carotid arterial blood perfusing the brain since the latter is additionally cooled by countercurrent heat exchange (selective cooling).

In contrast, vertebral artery blood is not thermally conditioned by selective heat exchange and enters the circle of Willis at the same temperature as the blood leaving the aortic arch. The difference between vertebral blood temperature (systemic cooling only) and carotid blood temperature (both systemic and selective cooling) is determined by selective heat loss and is, therefore, a quantitative indicator of the intensity of selective brain cooling. Practically, this difference may