

6219

Heat Regulation in Medullary and Mid-brain Preparations.

A. D. KELLER AND W. K. HARE.

From the Department of Physiology and Pharmacology, University of Alabama School of Medicine.

One of us approached the localization of the central mechanism for the control of body temperature by attempting to determine if the fibre tracts concerned could be delimited as they passed caudally through the brain stem.^{1, *} It was soon noted that a medullary preparation differed markedly from a mid-brain preparation in its ability to heat regulate. The absence of heat regulation in a mid-brain preparation has long been known; this fact was demonstrated particularly well by Bazett and Penfield² in chronic mid-brain and pontile cats. Bazett³ more recently emphasized that he has never been able to elicit shivering in such a preparation, yet Dworkin⁴ reports shivering in acute medullary rabbits.

Our observations have been derived from some 30 mid-brain preparations and 10 or more medullary animals, of which 4 only were maintained more than 2 days postoperative. The mid-brain preparations exhibited the following reactions: (a) shivering was never observed even when the rectal temperature was lowered in the ice box to 26°C.; (b) it was always necessary to keep the animals in a heated incubator in order to maintain a relatively normal temperature⁵; (c) hyperthermia never resulted from central trauma, meningitis, or from other infections such as peritonitis and consolidation of the lungs; (d) sweating was never observed to result, even when the rectal temperature was raised to 43-44°C.; (e) typical panting has been observed only in a very few instances and in these cases the sections were high, but respiratory rates of 120 were frequently obtained on over-heating.

On the other hand, medullary preparations responded as follows: (a) shivering was readily elicited and frequently occurred in the acute stage as a result of heating or after injecting hot saline subcu-

¹ Keller, A. D., *Am. J. Physiol.*, 1930, **93**, 665.

* The final observations in this particular problem are being withheld from publication until the present study has been extended further.

² Bazett, H. C., and Penfield, W. G., *Brain*, 1922, **45**, 185.

³ Bazett, H. C., *Abstracts Am. Physiol. Soc.*, 1932.

⁴ Dworkin, S., *Am. J. Physiol.*, 1930, **93**, 227.

⁵ Keller, A. D., *Am. J. Physiol.*, 1932, **100**, 576.

taneously, as well as from cooling or injecting cold saline subcutaneously; (b) although the preparations were housed in a heated incubator directly following operation, within a few days they maintained an adequate rectal temperature in unheated cages; (c) hyperthermia was observed in 2 instances at ordinary room temperature where the lesion was highly traumatic, with sub-stem hemorrhage; (d) heating the animals resulted in a progressive slowing of respiration and finally periodic breathing, of the nature that occurs immediately after making the brain lesion⁶; (e) sweating has not been observed, however, young animals have not been used. No cases of infections have been seen.

The difference between 2 such preparations, *e. g.*, in their ability to maintain a rectal temperature of relatively normal range when subjected to a low environmental temperature, was readily demonstrated by preparing the animals simultaneously and then placing them in the same incubator. In this case if the box was regulated to maintain the temperature of the mid-brain animal, the medullary preparation soon died of hyperthermia; on the other hand, if the box was regulated for the medullary preparation the temperature of the mid-brain animal was markedly low. This contrast is shown in the following table:

TABLE I.

Day	Cat 103—Medullary		Cat 104—Midbrain		
	Rect. Temp. °C.	Box Temp. °F.	Rect. Temp. °C.	Box Temp. °F.	
5	35	82	31	85	
6	38	80	32	82	
7	37.7	74*	32.5	82	
8	41	80*	Died from tracheal obstruction		
8:45 a. m.	Icebox	50			
10:30	37.7	Typical generalized shivering.			
12 noon	36	Cat taken out. Still shivering			
2:00 p. m.	38.7	78* No shivering			

* Animal in unheated cage.

⁶ Keller, A. D., *Am. J. Physiol.*, 1931.