REACTION OF THE BLOOD VESSELS ON THE SURFACE OF THE RABBIT'S BRAIN TO TEMPERATURE

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The activity of the cardiovascular system of rabbits is distinguished from that of other species of laboratory animals by certain physiological properties, including a lower intravascular pressure at its various levels [1-4].

The problem of the influence of heating and cooling on the blood vessels on the brain surface has received inadequate attention in the literature [6-12].

This paper presents comparative data relating to the reactions of the blood vessels on the brain surface of rabbits and cats to heating and cooling.

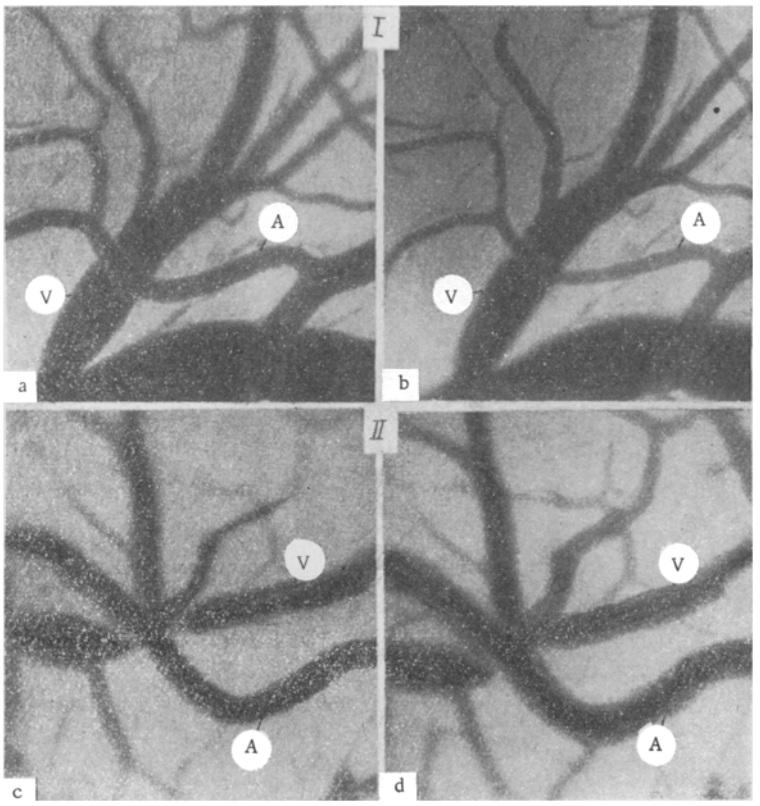

Fig. 1. Changes in the diameter of the vessels on the surface of a rabbit's brain before (a and c) and after (b and d) heating (I) and cooling (II). A) Arteries; V) veins. Photomicrographs 50×.

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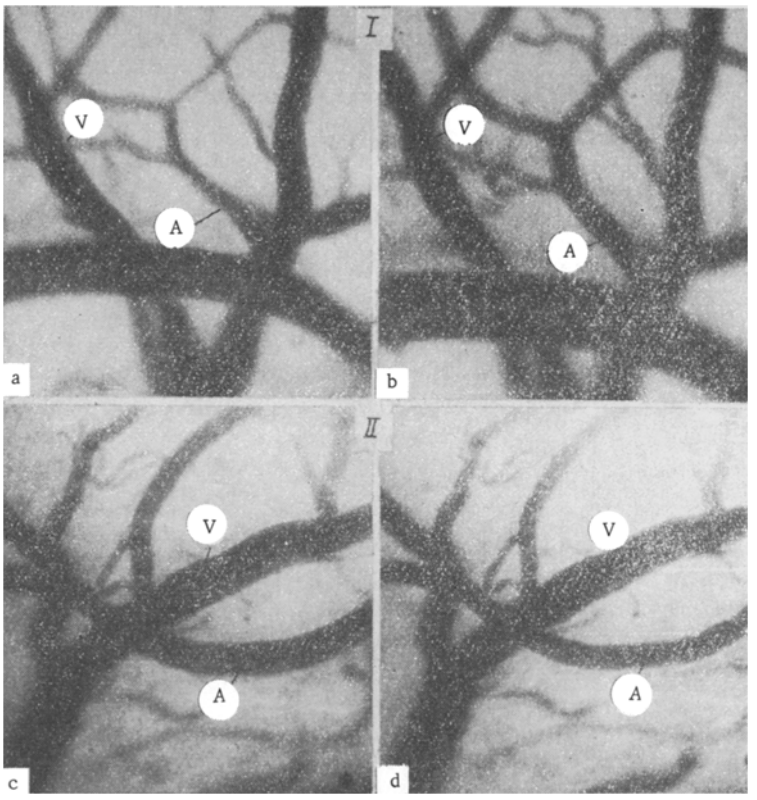

Fig. 2. Changes in the diameter of the vessels on the surface of a cat's brain before (a and c) and after (b and d) heating (I) and cooling (II). A) Arteries; V) veins. Photomicrographs. 50×.

EXPERIMENTAL

Altogether 24 experiments were carried out on rabbits anesthetized with urethane (1 g/kg) and 21 experiments on cats under urethane (1.5 g/kg) or inhalation anesthesia.

In some of the experiments a "window" was screwed into a trephine hole in the parietal region of the cerebral cortex and the brain surface was exposed to changes of temperature by heating or cooling the glass of the window. Heating was carried out with the light bulb of a capillaroscope, the heating effect of which was shown by a control test with a heat filter and by irrigating the glass of the window with physiological saline heated to 48, 55, or 60°. Cooling was achieved by applying ice to the window for 5-15 min.

Experiments with an open skull and without a "window" were also carried out, in which the degree of heating or cooling was determined from the readings of a type NIIEKhAiI thermograph (the thermistor pick-up was placed on the brain surface). The effect of continuous irrigation of the brain surface for 15 min with physiological saline having a temperature at the brain surface of 38, 42, and 45° or 30, 27, 22, 17, 12, and 8° on the blood vessels was observed. Control tests showed that irrigation of the brain surface with physiological saline at the same temperature as the brain surface (36°) has no effect on the diameter of the vessels.

The changes in the diameter of the vessels were recorded by microphotography using a capillaroscope or were observed visually, using a type MBS-2 microscope and a linear ocular micrometer for measuring.

EXPERIMENTAL RESULTS

Observations on the vessels on the surface of the rabbit's brain when heat was applied from the illuminating lamp showed that after heating for 1-2 min the arteries on the brain surface began to constrict (Fig. 1). The degree of constriction reached its maximum after 5 min (by 10-20% of the initial diameter).

After the heating had been discontinued the diameter of the arteries returned to its original value. This effect was not observed if the heat filter was placed in front of the illuminating lamp. Heating the surface of the "window" with hot physiological saline in most experiments likewise caused constriction of the arteries or no change in their diameter. Irrigation of the brain surface with physiological saline at a temperature of 38, 42, or 45° caused constriction of the arteries on the brain surface of the rabbits in the overwhelming majority of experiments by 15-20%, and the effect began 1-2 min after heating commenced.

In the cats, heating the surface of the "window" for 15 min with the illuminating lamp of the capillaroscope did not alter the diameter of the blood vessels. When the surface of the window was heated with warm physiological saline, the arteries were seen to dilate by 8-10%. Heating the brain surface with physiological saline at temperatures of 38, 42, or 45° for 10-15 min usually caused no change in the diameter of the arteries or dilated them by 15-25% after 4-5 min (Fig. 2).

When the surface of the window was cooled by the application of ice for 5-15 min, the arteries on the surface of the rabbits' brain quickly dilated by 15-40% of their initial diameter (Fig. 1). The arteries of these animals showed the same type of reaction when the brain surface was cooled directly with physiological saline at temperatures of 30, 27, 22, 17, and 12°.

When the surface of the window in the cats was cooled with ice, constriction of the arteries by 10-30% was observed (Fig. 2), but not in all the experiments. Cooling of the surface of the cats' brain with physiological saline at temperatures of 30 and 27° for periods of up to 15 min caused no changes in the diameter of the vessels; with physiological saline at temperatures of 22, 17, 12, or 8° the arteries were constricted by 10-40% of their original diameter.

In all the experiments the changes in the diameter of the arteries arising under the influence of heating or cooling were reversible.

As a rule, the diameter of the veins on the brain surface remained unchanged. Slight (by 5-7%) dilation of the veins was noted in the experiments on the rabbits when the arteries dilated by 50% of their initial diameter as a result of cooling of the "window" with ice.

Comparison of the reactions of the arteries on the brain surface of cats and rabbits to heating and cooling showed that these reactions to the same stimulus were opposite in character. On the other hand, these results demonstrate the high sensitivity of the arteries on the surface of the rabbit's brain to changes of temperature. This conclusion is in agreement with reports in the literature that the vessels on the surface of the brain of animals at the lower levels of evolution are more sensitive to mechanical and electrical stimulation [5, 6].

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