EFFECT OF SUBCUTANEOUS AND SUBOCCIPITAL INJECTION OF SEROTONIN ON GLUCOSE CONSUMPTION OF THE BRAIN

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Serotonin is an essential substrate for the normal activity of the central nervous system. If it is administered from outside sources, symptoms of disturbances of brain functions are observed [1-7]. However, the available evidence is insufficient to explain the mechanism of development of the nervous syndrome, whether it is due to the direct action of serotonin on the neurons or the result of local spasm of the blood vessels.

It is now known that nervous disorders are frequently observed in associated with disturbances of carbohydrate metabolism in which the glucose consumption of the brain is lowered.

In the present investigation the effect of serotonin was studied on the sugar consumption of the brain following subcutaneous injection of this substance and also after its direct action on the nerve centers.

EXPERIMENTAL METHOD

Experiments were carried out on dogs. Serotonin was injected subcutaneously and suboccipitally in physiological saline in doses of 1 and 5 mg/kg. Blood for estimation of sugar was taken from the femoral artery and longitudinal sinus of the brain.

TABLE 1. Glucose Consumption of the Brain following Subcutaneous and Suboccipital Injection of Various Doses of Serotonin, M±m

Mode and dose of injection of serotonin in (mg/kg)	No. of animals	Arterio-venous difference in glucose concentration (in mg%)			
		before injection of serotonin	after injection of serotonin		
			15 min	60 min	120 min
Subcutaneously 1	6	11.0±1.10 (87.7±3.8; 77.0±3.5)	13.0±0.80 P > 0.10 (94.0±4.3; 81.3±3.8)	11.0±1.40 P > 0.10 (93.5±5.9; 82.±±6.4)	12.0±1.60 P > 0.10 (94.0±7.0; 82.5±6.4)
5	5	13.0±1.10 (93.2±1.4; 80.4±1.3)	12.0±1.00 P > 0.10 (104.3±3.0; 91.4±3.8)	11.0±1.10 P > 0.10 (96.8±6.2; 85.4±6.7)	13.0±1.60 P > 0.10 (89.0±2.8; 76.0±3.9)
Suboccipitally 1	5	10.0±1.30 (84.8±1.4; 74.8±4.0)	14.0±1.70 P > 0.05 (93.8±4.4; 88.2±7.0)	9.0±1.30 P > 0.10 (87.2±5.6; 78.2±4.9)	12.0±1.30 P > 0.10 (86.2±1.7; 74.6±2.6)
5	7	9.0±1.00 (86.6±3.2; 72.0±2.3)	11.0±1.40 P > 0.10 (85.0±4.6; 75.4±4.8)	11.0±1.00 P > 0.10 (89.8±5.8; 79.2±5.0)	8.0±1.60 P > 0.10 (86.0±6.6; 77.8±10.5)

Note: The first numbers in parentheses denote the glucose level in the arterial blood, the second — in venous blood.

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EXPERIMENTAL RESULTS

As Table 1, shows, injection of serotonin was not accompanied by any significant changes in the blood sugar level. The slight increase in the blood glucose level was evidently dependent on the character of the reaction exhibited by the animals. Depending on the dose, the animals became restless, showed motor activity, became short of breath, salivated, developed convulsions, and so on. These manifestations depended on the mode of injection of the preparation. When serotonin was applied directly to the nerve centers in a dose of 1 mg/kg, disturbances of brain function began rapidly. The same dose when given by subcutaneous injection had no appreciable effect on the central nervous system. Subcutaneous injection of the preparation in a dose of 5 mg/kg was accompanied by disturbance of the brain functions which continued for about 60 min; none of the animals died in these circumstances. When serotonin was injected suboccipitally in a dose of 5 mg/kg, nervous disorders began quickly and the animals died 2.5-3 h later from respiratory paralysis. These results showed that serotonin may accumulate in the brain. In this state the conduction of impulse in the neurons is modified, thus disturbing the regulatory activity of the central nervous system. The subcutaneous injection of serotonin was not accompanied by accumulation of the drug, for on its path to the brain a large proportion of the drug was destroyed by amine oxidase.

Serotonin had no effect on the glucose consumption of the brain whether injected subcutaneously or suboccipitally.

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