# CALORIGENIC EFFECT OF DOPAMINE IN RATS

E. M. Stabrovskii and L. S. Shpanskaya

UDC 615.357.452.015.42:612.5

Injection of 200 mg/kg DOPA into rats adapted to temperatures of 5 and 22°C did not affect the gas exchange or rectal temperature. Injection of 10 mg/kg dopamine into the same rats was followed by an increase in these parameters and in the blood glucose concentrations without any substantial changes in the content of free fatty acids. The calorigenic effect of dopamine was much more marked in rats adapted to cold.

Previous experiments [3, 4] showed that short and long exposures to moderate cold (5°C) induces considerable changes in the concentrations of catecholamines and their precursors in the tissues of rats and an increase in the excretion of these amines in the urine. The calorigenic effect of catecholamines differs in animals of different species and it also differs for adrenalin and noradrenalin [5, 6, 10-13].

Because of the absence of data on a possible calorigenic effect of dopamine and because of evidence of a mediator function of its own [1, 14], it was decided to study the effect of dopamine on the oxygen consumption, carbon dioxide elimination, rectal temperature, and blood levels of glucose and free fatty acids.

## EXPERIMENTAL METHOD

Experiments were carried out on male albino rats weighing 200-220 g. One group of animals was kept in a room with an air temperature of 5 ± 1°C. The other group of rats was kept at a temperature of 22 ± 1°C. After 3 days the animals were given an intraperitoneal injection of L-dopamine sulfate (Schuchardt München, West Germany) in a dose of 10 mg/kg or of DL-DOPA (Reanal, Hungary) in a dose of 200 mg/kg. The dose of dopamine was chosen allowing for its concentration in the adrenals [3, 4], and the dose of DOPA allowing for the fact that 200 mg/kg is the threshold dose producing changes in the catecholamine concentration in the brain [9] and other organs [15] in rats. The calorigenic effect of dopamine and DOPA was judged from the change in gas exchange and rectal temperature measured with an electrothermometer [2]. The concentrations of glucose and free fatty acids were determined in the animals' blood [8].

TABLE 1. Rectal Temperature (in °C) in Rats Adapted to Temperatures of 22 and 5°C After Intraperitoneal Injection of DOPA (200 mg/kg) and dopamine (10 mg/kg) (M ± m)

| Time after injection (in min) | No. of animals | Temperature after injection of DOPA | | | | Temperature after injection of dopamine | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | adaptation to 22°C | P | adaptation to 5°C | P | adaptation to 22°C | P | adaptation to 5°C | P |
| Before injection | 20 | 38,0±0,15 | | 38,2±0,22 | | 38,2±0,11 | | 38,3±0,11 | |
| After injection | | | | | | | | | |
| 10 | 20 | 37,6±0,15 | >0,05 | 38,0±0,18 | >0,05 | 37,8±0,16 | >0,05 | 39,1±0,13 | <0,002 |
| 20 | 20 | 37,3±0,31 | >0,05 | 37,9±0,13 | >0,05 | 38,0±0,22 | >0,05 | 39,8±0,11 | <0,001 |
| 30 | 20 | 37,4±0,20 | >0,05 | 38,1±0,15 | >0,05 | 37,9±0,11 | >0,05 | 39,1±0,24 | <0,005 |

Department of General Clinical Pathology and Department of Biochemistry, Central Research Laboratory, S. M. Kirov Leningrad Postgraduate Medical Institute. (Presented by Academician of the Academy of Medical Sciences of the USSR V. S. Il'in.) Translated from Byulleten' Éksperimental'noi Biologii i Meditsiny, Vol. 77, No. 3, pp. 26-28, March, 1974. Original article submitted December 19, 1972.

TABLE 2. Blood Glucose and Serum Free Fatty Acid Concentrations in Rats Adapted to 22 and 5°C 30 min After Intraperitoneal Injection of 10 mg/kg Dopamine (M ± m)

| Substance tested | No. of animals | Control | Adaptation to 22°C | P | Adaptation to 5°C | P |
|---|---|---|---|---|---|---|
| Glucose (in mg %) | 30 | 91±2,4 | 193±16 | <0,001 | 161±11 | <0,001 |
| Free fatty acids (in meq/liter) | 30 | 1591±33 | 1607±42 | >0,05 | 1624±44 | >0,05 |

## EXPERIMENTAL RESULTS AND DISCUSSION

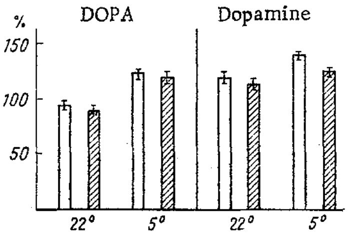


Fig. 1. Effect of DOPA and dopamine on the gas exchange in rats adapted to 22 and 5°C. Unshaded columns – oxygen consumption, shaded columns – $CO_2$ elimination (in % of control). Limits of variation of index are given.

DOPA in a dose of 200 mg/kg did not change the rectal temperature of either group of animals 10, 20, and 30 min after the injection (Table 1). Similar results were obtained after injection of dopamine into the group of warm-adapted (22°C) rats. Injection of dopamine into the cold-adapted (5°C) rats, on the other hand, was followed by a distinct rise of rectal temperature.

DOPA caused no change in the $O_2$ consumption or $CO_2$ elimination 30 min after its injection in the warm-adapted rats. In the cold-adapted rats, on the other hand, an increase of about 20% in the gas exchange was observed after injection of DOPA (Fig. 1). Dopamine also caused a slight increase in the gas exchange of the warm-adapted animals. The oxygen consumption in this group of animals was increased by 40% and the carbon dioxide elimination by 26%.

Incidentally, no increase of body temperature was observed in those rats whose gas exchange was not increased by more than about 20% as a result of the injection of DOPA or dopamine. With a greater increase in oxygen consumption (as took place after injection of dopamine into cold-adapted rats) the body temperature was definitely increased.

The increase in gas exchange under the influence of catecholamines is dependent on many of their metabolic effects such as glycogenolysis, mobilization of fatty acids, increased lactic acid production, and so on. As the results in Table 2 show, 30 min after injection of dopamine the glucose concentration in the blood of both groups of rats studied was clearly increased. The free fatty acid level was not significantly changed. This indicates a similarity between the effects of dopamine and those of adrenalin, but not those of noradrenalin.

## LITERATURE CITED


1. B. N. Manukhin, Physiology of the Adrenoreceptors [in Russian], Moscow (1968), p. 5.
2. R. P. Ol'nyanskaya and L. A. Isaakyan, Methods of Investigation of the Gas Exchange in Man and Animals [in Russian], Leningrad (1959).
3. E. M. Stabrovskii and K. F. Korovin, Fiziol. Zh. SSSR, No. 4, 539 (1971).
4. E. M. Stabrovskii and K. F. Korovin, Fiziol. Zh. SSSR, No. 3, 414 (1972).
5. J. Chatonnet, M. Tanche, and J. G. Guieu, J. Physiol. (Paris), 53, 296 (1961).
6. W. H. Cottle, Canad. J. Biochem., 41, 1334 (1963).
7. K. M. Dubowscki, Clin. Chem., 215, 8 (1962).
8. W. G. Duncombe, Biochem. J., 88, 7 (1963).
9. G. M. Evert and R. G. Wiegand, in: Proceedings of the Fifth International Pharmacological Meeting, Vol. 8, Oxford (1962), p. 85.
10. A. C. L. Hsieh and L. D. Carlson, Am. J. Physiol., 190, 243 (1957).
11. L. Jansky, R. Bartunkova, J. Kokkova, et al., Fed. Proc., 28, 1053 (1969).
12. L. Jansky, R. Bartunkova, and E. Zeisberg, Physiol. Bohemoslov., 16, 366 (1967).
13. J. Le Blanc, Am. J. Physiol., 212, 530 (1967).
14. P. Liu, L. J. Krenis, and S. H. Ngai, Anesthesiology, 34, 4 (1971).
15. T. Persson and B. Waldeck, Acta Pharmacol. (Copenhagen), 29, 525 (1971).