Effect of Dimethyl Sulfoxide on the Urinary Excretion and on the Hypothalamic Neurosecretory Substance of the Rat

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Summary. Dimethyl sulfoxide (DMSO) ingested in drinking water (5%) caused a 4--5-fold increase in the urinary volume of the rats. Aldehyde-fuchsin and chromalaun-hematoxylin stainings revealed a practically complete loss of neurosecretory material in the pituitary gland, and some days later also in the supraventricular and paraventricular nuclei as well as in the hypothalamo-hypophyseal tract. Injections of Pitressin® (0.2 ml × 6) during DMSO-treatment decreased the urinary volume to one half and injection of Esidrex® about 25%. DMSO is suggested to effect the kidneys directly rather than by inhibiting the synthesis and release of the anti-diuretic hormone.

Key-Words: Dimethyl sulfoxide — Diuresis — Neurosecretion — Pituitary gland, posterior — Pituitary hormones, posterior.


Dimethyl sulfoxide (DMSO) is an industrial solvent which was introduced to medicine as a pharmacotherapeutic topical agent by Jacob et al. [6]. It was characterized to alter membrane permeability, to block nerve conductivity, to be analgesic, anti-inflammatory and bacteriostatic, as well as tranquilizing and to potentiate the effect of concomitantly applied drugs. It has been used clinically, for rheumatic disorders, for degenerative diseases of skeletal system, and connective tissue as well as
other inflammatory diseases. The beneficial as well as adverse effects of DMSO when used as a drug by itself or as a vehicle have been discussed in numerous reports during the last 10 years (For ref. see [9]). The diuretic effect of DMSO in dogs was reported already by Jacob et al. and later it has been shown by Farrant [2] that DMSO increases the uptake of water in mice. It has not been studied at which level of regulation DMSO has its effect.

Material and Methods

Adult male rats of Long-Evans strain, weight 200—260 g, were used as experimental animals. DMSO (Dimethylsulfoxide zur Synthese, Merck AG, Darmstadt, Germany) was given at 5% concentration in drinking water ad libitum to 30 rats. 20 rats kept in identical laboratory conditions served as controls. 5 rats of the experimental group and three controls were killed 1, 2 and 3 weeks and 1, 3 and 6 months after the beginning of the experiment. Brain, hypophyseal gland and kidneys were removed and fixed in Bouin’s fixative, dehydrated and embedded in paraffin and sectioned at 6 μ.

For demonstration of the neurosecretory material the sections were stained according to the BARGMAN’S [4, 5] modification of GOMORI’S chromalaun-hematoxylin-phloxin method as well as using aldehyde-fuchsine (LANDING’S modification of Gomori’s method [7]).

The rats were kept during the experiment in metabolic cages of two animals and the urinary volumes were measured daily. Antidiuretic hormone (ADH, Pitressin®, Parke-Davis, England) was injected subcutaneously 0.2 ml (4 IU) 6 times at 6 h intervals to 5 of the rats receiving DMSO. About 2 weeks later the same animals were injected with hydrochlorthiazide (Esidrex®, Ciba, Switzerland) at a dose of 0.2 ml (5.0 mg) 4 times at 6 h intervals. The effect of those substances on the urinary volume was recorded.

Results

General Observations

The weight of the DMSO-treated animals decreased about 20 g during the first 10 days of experiment but, thereafter, increased so that the starting weight was reached 3 weeks later. Thereafter, the weight curves run parallelly in the experimental and control groups. The control rats drank about 13—17 ml per day while the amount of the mixture drunk by the experimental animals rose up to 55—65 ml per day. The autopsy findings did not reveal any macroscopic pathologic changes in the internal organs of the experimental or control animals.

Urinary Volume

The urinary volume of one rat during a part of the experiment is recorded in Fig. 1. 3 days after the beginning of the experiment the urinary volume had increased up to a level of 3.5 fold over the controls. After the 5. week the volume had increased at a level about 4—4.5 fold over the controls. After transferring the animals to normal drinking water, the urinary volume reached the control level in 6 days.