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SUBACUTE EXPOSURE TO TOLUENE CHANGES THE SPATIAL MEMORY IN RATS

Toluene is a major component of numerous commercial organic solvent formulations. We have investigated the effect of an inhalation exposure of 150 ppm for 4 weeks (4 h/day, 5 days/week), followed by a postexposure period of at least 4 weeks, on rat behavior in a Morris swim maze. Toluene-exposed rats showed significantly increases latency to the platform. The present results indicate that exposure to low concentrations of toluene leads to persistent effects on cognitive properties in the rat.

Keywords: toluene exposure, organic solvent, behavior, spatial memory, rats.

Toluene is an aromatic volatile organic compound that is one of the most commonly used substances in industry and commerce. Toluene is a constituent of gasoline, and is present in numerous other consumer products including glues, cleaning products and oil-based paints [9]. Because of the large volume of use and ubiquitous exposure, it is important to develop an accurate understanding of the risks of exposure to toluene. Occupational exposure to organic solvent vapors may cause long-term functional disturbances in the central nervous system (CNS) known as the solvent syndrome. Impaired learning ability and memory, and changes in the sphere of emotions are the main characteristics of the syndrome [1, 3, 7]. Number of studies demonstrated that toluene have effects to central nervous system depressants [4, 6] but little data exists that assesses subacute low-level toluene's effects on cognitive functions, which promise to expand understanding of toluene's diverse central toxicity. The aim of our experiment was to find out whether inhalation exposure to toluene may lead to long-term changes in the behavior of rat in Morris water maze.

Material and methods. Adult Wistar male rats were used in our experiment. The animals were kept in single breeding cages under standard conditions (12h/12h light on/dark cycle, 22°C-24°C temperature, 50–60% relative humidity). Water and standard food were accessible to the animals ad libitum. The rats were exposed to toluene in 0,2m^3 chambers during 4 weeks (5 days/week, 4 h/day). During the exposure, neither food nor water was accessible to the animals. Morris water maze was used as the basis for assessing the effects of toluene exposure on navigating learning and spatial memory. The maze was a circular 150-cm diameter swimming pool made of white PVC and filled 30-cm deep with 26 ±1 °C water. An18-cm diameter white PVC platform was submerged 1,5 cm under the water surface level. Diffuse ceiling lighting provided additional illumination (≈6,5 lux at the surface of the pool).

The rats were brought to a waiting room at least 30 min before the experiments and were kept in holding cages shortly before testing. At the beginning of each trial, they were individually placed into the pool facing the wall. Within 2 days each animal 4 times placed in a water waze and registered latency to the platform, once on the platform, it was left there for 60 s. After four trials each day, the rats were dried with paper towels and heated by two 75-W light bulbs. Testing took place during the day-time between 9.00 and 17.00 hours.

Paired comparisons between independent groups were done by means of the Mann–Whitney *U* test. All statistical analyses were done using the Statistica program (StatSoft, version 6.0.).

Results. As shown in Table 1, toluene at 150 ppm produced a significantly increases latency to the platform. The median (LQ;UQ) time of search of the platform in control and toluene-treated rats were 43,5 (32,8; 65,5)s and 70,5 (40,0; 84,5)s, respectively. At testing in 24 hours significant differences between groups were not recorded.

Thus, our results show that water maze tasks after prolonged toluene exposure at 150 ppm failed to show reliable impairments in spatial and working memory of rats. We assume that in a basis of observable infringements changes lay multiple neurotransmitter systems modulated by toluene exposure. Though the dopaminergic system appears to be a natural site of action for toluene [2,8], given its abuse potential, reported psychotic symptomatology, and parkinsonian symptoms in chronic abusers, a number of features suggest that independent cholinergic pathways may also be important in understanding the neural mechanisms of toluene's CNS effects [5]. The mechanisms underlying these differences are the matter of ongoing investigation.

Table 1

Latency to the platform in Morris maze of rats exposed to toluene

	Latency to the platform, s	
	First testing	Testing in 24 hours
No exposure	43,5 (32,8; 65,5)	32,3 (20,0; 45,8)
Toluene exposure	70,5 (40,0; 84,5)*	40,3 (23,8; 70,0)

Note. * $p < 0,05$

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