

The Effects of Oil Paint Vapor on Thermal Pain Sensitivity in Male Rats

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Abstract: Oil paint is a type of chemical colors dependent on the type and composition make multiple risks for our health. The aim of this study was to investigate the effects of oil paint vapor on thermal pain sensitivity in male rats. In this laboratory experimental study, male rats were randomly divided to control and animals exposed to oil paint vapor. Data were analyzed using ANOVA. The results indicated that there was no significant increase in thermal pain resistance in rats exposed to oil paint vapor compared to the control group ($P < 0.05$). The findings suggest that oil paint vapors have a non-significant effect on enhancing of thermal pain sensitivity.

Keywords: Oil Paint Vapor, Thermal Pain Resistance, Male Rat

1. Introduction

Volatile Organic Compounds (VOCs) are organic chemicals that are volatile at ambient temperature and include chemical substances like benzene and formaldehyde that evaporates from oil paints and other resources. [1] VOCs in paint are considered harmful to the environment and especially for people who work with them on a regular basis. Exposure to VOCs has been related to organic solvent syndrome, although this relation has been somewhat controversial. [2] One of the most deleterious components existing in volatile organic compounds (VOCs) in paint is benzene. Benzene is commonly found in air in both urban and rural areas, but the levels are usually very low. Exposures can be higher for people in enclosed spaces with unventilated fumes from gasoline, glues, solvents, paints, and art supplies. [3] A major source of man-made VOCs is coatings, especially paints and protective coatings. Solvents are required to spread a protective or decorative film. Typical solvents are aliphatic hydrocarbons, ethyl acetate, glycol ethers, and acetone. Motivated by cost, environmental concerns, and regulation, the paint and coating industries are increasingly shifting toward aqueous solvents. [4] The major of people are exposed to oil paint vapor in industrial places (for example car factory and etc.) [5] Therefore, investigating of impact factors in the long-term inhalation of oil paint is required. [6] Various solvent is used as oil paints thinner such as Toluene, Methyl Ethyl Ketone (MEK), Di Methylformamide (DMF), 2-Butoxyethanol, Ethylbenzene, Xylene. [7] All of these materials are a widely abused solvent with demonstrated addictive potential in humans. [8]

A nociceptor is a sensory nerve cell that responds to damaging or potentially damaging stimuli by sending signals to the spinal cord and brain. This process, called nociception, usually causes the physical sensation of pain in sentient beings.

In mammals, nociceptors are sensory neurons that are found in any area of the body that can sense noxious stimuli either externally or internally. External examples are in tissues such as skin and internal nociceptors are in a variety of organs, such as the muscle. The cell bodies of these neurons are located in either the dorsal root ganglia or the trigeminal ganglia. [9] Thermal nociceptors are activated by noxious heat or cold at various temperatures. There are specific nociceptor transducers that are responsible for how and if the specific nerve ending responds to the thermal stimulus. The detection and rapid avoidance of noxious thermal stimuli is crucial for survival. [10] Thermosensation is important to the well-being of an organism, allowing escape from potentially damaging environments or stimuli, but also contributing to the maintenance of body temperature. [11] Females are more vulnerable than males to development of numerous chronic pain conditions – e.g., fibromyalgia, temporomandibular joint pain, back pain, irritable bowel syndrome, headache and arthritis. [12] The idea has been that individuals with high pain sensitivity when healthy are most likely to express chronic pain in response to pathology. [13] A variety of chronic pain conditions are more prevalent for females, and psychological stress (with attendant sympathetic activation) is implicated in development and maintenance of these conditions. [14] Here we explore if inhalation of oil paint vapor in male rats has effects on thermal pain sensitivity.

2. Material And Methods

2.1. Animals

Adult male rats weighting 200±30g were purchased and raised in our colony from an original stock of Pasteur institute (Tehran, Iran).The temperature was at 23±-2 0C and animals kept under a schedule of 12h light:12h darkness (light on at: 08: 00 a.m.) with free access to water and standard laboratory chow. Care was taken to examine the animals for general pathological symptoms. Food was withheld for 12-14h before death. In all experiments, attention was paid to the regulations of local authorities for handling laboratory animals, and the Ethical Guidelines for investigation of experimental pain in conscious animals issued by the ad-hoc Committee of the International Association for the Study of Pain [15].

2.2. Tail Immersion Test

Testing proceeded in two daily sessions near mid-photophase (10:00 AM to 12:00 noon; 2:00-4:00 PM) to reduce circadian effects on nociceptive and analgesic sensitivity. [16] The test was performed according to a previous report with modifications. [17] The rats were held in a cloth restrainer during testing. This method of restraint is a less stressful means of containing rats during tail-flick testing and has been to shown to reduce variability in response latencies compared with commercial restrainers. [18] The end of the tail (5 cm) was placed in a 50°C water bath (49.5–50.5°C). This water-bath temperature was shown to produce a stable noxious stimulus. [19] The pain threshold was measured as the time required to elicit a flick of the tail called analgesia time.

2.3. Protocol of Study

Male rats were randomly divided into control animals, and rats that received oil paint vapor for 1 hour and for 8 hours. The end of the tails of oil paint vapor receiving rats, were placed in a 50°C water bath after exposing to oil paint vapor. Control rats also were placed in the water bath as same as other animals. The test was performed for 300 sec for each rat and was repeated twice at 5-day interval. High levels of resistance were measured by increased length of time for the animal to raise its tail from the water bath. All animal experiments were carried out in accordance with the guidelines of Institutional Animal Ethics Committee.

2.4. Statistical Analysis

All values are presented as mean ± S.E.M. Statistical significance was evaluated by one-way analysis of variance (ANOVA) using SPSS 19. Differences with P<0.05 were considered significant.

3. Results

Figure I shows resistance time of groups against thermal pain through tail withdrawal test.

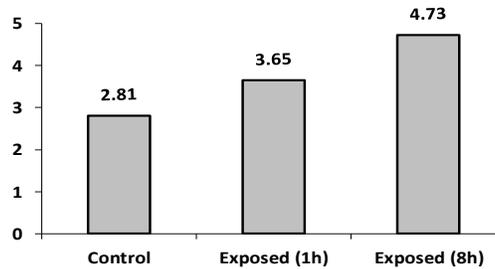


Fig. I. Resistance time against thermal pain in control group and groups exposed to paint oil vapor for 1h/day and 8h/day

Our findings indicated that there was no significant difference in resistance to thermal pain between control and groups exposed to 1h/day and 8h/day.

4. Discussion

Our study indicated that exposure to oil paint vapor results in enhanced thermal pain sensitivity. Although odor pollution of air in small amount is not harmful to the health of man, [20] it is high amount of odor which can lead to problems in human health. In developing countries, there are many chemical products still being used despite their well-known adverse health outcomes. Since benzene exposure is considered one of the possible causes of morbidities among automobile workers, investigations primarily focused on behavioral aspects of workers and conditions in the workplace that may increase chances of exposure and can be used to predict future health risks. Benzene mostly arises from fuel vapors and gasoline but occupationally, benzene exposure occurs in workplaces like refineries, garages, and paint manufacturing. [21] Common exposures of VOCs involved workers at industries for example spray painting industry and it is become an issue to the workers incorporating in these activities. Although painting also used in others activity such as wood based, metals and others. [22] Many building materials such as paints slowly emit formaldehyde, which irritates the mucous membranes and can make a person irritated and uncomfortable. [23] The long-term exposure to VOCs in the indoor environment can contribute to sick building syndrome. [24] Also, Studies show that relative leukemia and lymphoma can increase through prolonged exposure of VOCs in the indoor environment. [25] Paint also is referred to as a source of recontamination of houses in urban environments and its role in maintaining elevated blood leads in children. [26] It seems that components of paint odor, in particular benzene, have a significant part in development of blood system disorders in subjects exposed to paint odor. [27] Respiratory, allergic, or immune effects in infants or children are associated with man-made VOCs and other indoor or outdoor air pollutants. [28] The studies also show that exposure to oil paint vapor can result in cancer and tumor occurrence. [29]

The skin contains thermally sensitive receptors leading to pain sensation known as thermal nociceptors that respond to noxious or harmful temperatures. Nociceptors that are responsive to temperature signal to the central nervous system that tissue damage is imminent and that the affected body part should be withdrawn immediately from the thermal source (e.g. a finger on a hot plate). [30] It is still unclear whether the quality of painful thermal sensation is determined only by conduction in specific, dedicated nociceptive channels (i.e. C or A δ nociceptors) or whether it is a result of integrated activity in both nociceptive and non - nociceptive systems. [31]

5. Conclusion

We have shown that oil paint vapor inhalation does not influence thermal pain sensitivity at least in short period.

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