

OLFACTORY AND RESPIRATORY EPITHELIAL IMPAIRMENT AND RECOVERY AFTER VANADIUM EXPOSURE IN RATS

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INTRODUCTION

Evidence suggests that environmental pollutants' fine particles are major risk factors for respiratory disorders. Vanadium, a metal component that induces metabolic changes in the respiratory system, is often present in these pollutants [1, 2]. This study determined the (sub)acute effects of vanadium exposure in the nasal respiratory (RE) and olfactory epithelium (OE).

MATERIALS AND METHODS

Forty-two adult *Wistar* rats were divided in six groups. Four groups were exposed to a solution of vanadium pentoxide (V_2O_5) by intranasal delivery three times a week for 4 weeks; each two groups were exposed to V_2O_5 at a concentration of 273 μg and 182 μg , respectively, in 30 μL of distilled water, two groups served as controls. Individuals from each one 273 μg and 182 μg and one control group were sacrificed after 4 weeks of exposure, the remaining two concentration and control groups four weeks after the last V_2O_5 administration. Full necropsy was performed, and the heads were processed for routine paraffin embedding and histopathological evaluation. All experiments were approved by the Portuguese Agency for Animal Welfare (general board of Veterinary Medicine in compliance with the Institutional Guidelines and the European Convention).

RESULTS

As expected, control group animals displayed normal RE and OE (Fig. 1 A). Exposure to higher doses of vanadium resulted in extensive coagulative necrosis of OE cells, with the exception of few basal cells (Figs. 1 B and C). The RE showed similar changes, but of focal nature. Four weeks after exposure, the OE was partially restored, but single cell necrosis, vacuolization of sustentacular cells, proteinaceous inclusions and histiocytes were still observed (Fig. 1D). The RE had fully recovered.

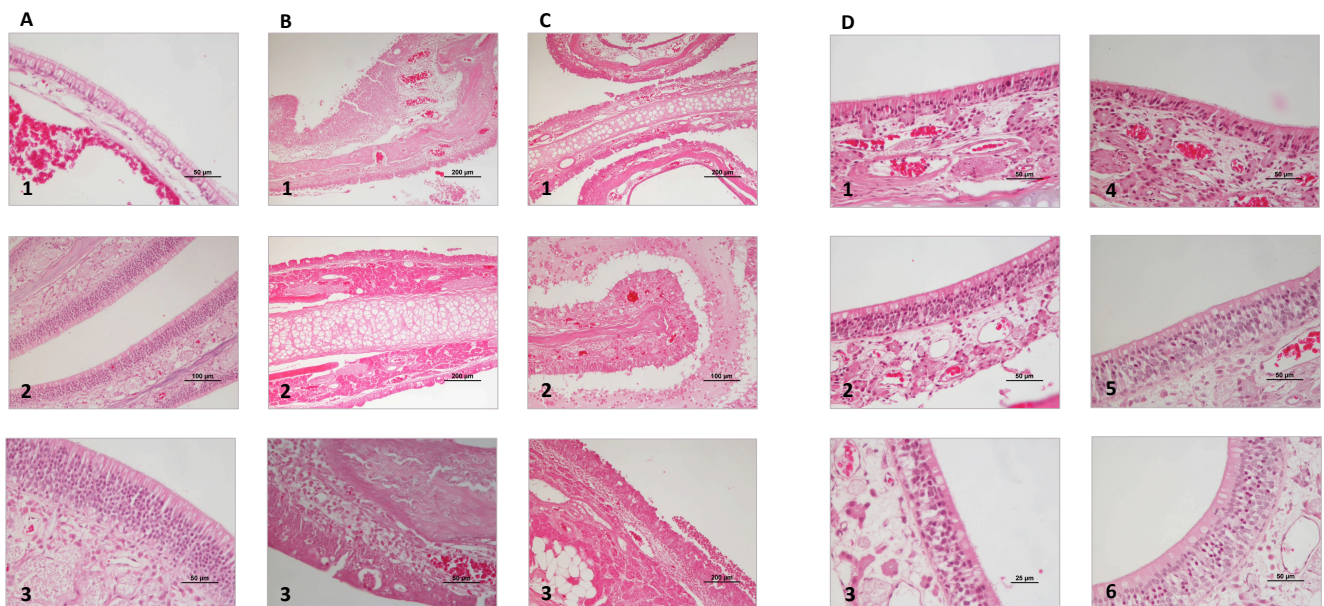


Fig 1. Microscopic images of H&E stained nasal cavity: (A) Control group, 1 - respiratory epithelium, 2, 3 - olfactory epithelium; (B) 182 μg of V_2O_5 exposed group 24h after the last administration, 1 - necrosis of respiratory and olfactory epithelium cells, 2, 3 - coagulative necrosis of olfactory epithelium cells; (C) 273 μg of V_2O_5 exposed group 24h after the last administration; 1 - respiratory and olfactory epithelium necrosis, 2, 3 - coagulative necrosis of olfactory epithelium cells; (D) 273 μg of V_2O_5 exposed group 4 weeks after the last administration: 1 - respiratory and olfactory epithelium inclusions, 2 - inclusions and single cell necrosis, 3 - vacuolization of sustentacular cells, 4, 5 and 6 - presence of histiocytes, vacuolization of sustentacular cells and single cell necrosis.

CONCLUSIONS

The results indicate that despite the severity of short-term effects, the OE maintains the ability to self-regenerate, and the RE fully recovers rapidly after intranasal vanadium exposure.

References

- Fortoul TI, Rodríguez-Lara V, González-Villalva A, Rojas-Lemus M, Cano-Gutiérrez G, Ustarroz-Cano M, Colín-Barenque L, Montaño LF, García-Pérez I, Bizarro-Neves P, López-Valdez N, Falcon-Rodríguez CI, Jimenez-Martínez RS, Ruiz-Guerrero ML, López-Zepeda LS, Morales-Rivero A, & Muñoz-Rivera-Cambas A. (2011). Vanadium inhalation in a mouse model for the understanding of air-suspended particle systemic repercussion. *Journal of biomedicine & biotechnology*, 2011, 951043. doi.org/10.1155/2011/951043
- Ngwa HA, Kanthasamy A, Jin H, Anantharam V, Kanthasamy AG. Vanadium exposure induces olfactory dysfunction in an animal model of metal neurotoxicity. *Neurotoxicology*. 2014 Jul;43:73-81. doi: 10.1016/j.neuro.2013.12.004

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