Occupational Exposure to PAHs Influence on Susceptibility to the X-ray Induced DNA Damage and Repair Capacity

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Frequently nowadays present in ambient air the polycyclic aromatic hydrocarbons (PAHs) are considered as potential human carcinogens. The aim of our study was to investigate whether occupational exposure to environmental PAHs may affect cellular susceptibility to the induction of DNA damage and its repair efficacy. In this study, performed in Prague (Czech Republic), in two seasonal samplings ($\sim$ 100 subjects in each sampling) lymphocytes, isolated from the whole blood samples collected from two groups of subjects, traffic policemen exposed to PAHs and from control, were examined for cellular capacities. The challenging dose (2Gy) of X-rays was applied as DNA strands breaks. An alkaline version of Single Cell Gel Electrophoresis (SCGE) assay was used to study DNA damage in the cells before challenging treatment, immediately after exposure and after the incubation allowing the cells to complete the fast repair process. In each in vitro experiment, lymphocytes from the same pool of healthy male donor's cells served as an internal standard. Significantly lower DNA repair efficiency of the X-rays induced damage was observed in PAHs-exposed donors (66.0% vs 76.4%, $p<0.003$ in the winter sampling; 57.7% vs 69.0%, $p<0.004$ in the summer sampling). Reduced repair efficiencies were observed in cells of donors exposed to PAHs after stratification according to smoking history (i.e. 54.2% vs 64.9%, $p<0.05$ in the smokers subgroup in summer sampling). Stratification according to genotype of donors was also done. Donors exposed to PAHs and heterozygous with the mutation in CYP1A1 gene (Ile/Val), despite much smaller number of such donors, exhibited significantly lower efficiency of repair (34.3% vs 62.7%, $p<0.04$). Donors belonging to the subgroup of slow acetylators (according to NAT2 genotype) who were exposed to PAHs were significantly less efficient in repair (64.7% vs 78.0%, $p<0.006$ in the winter sampling). Significantly reduced repair efficiencies were also observed for donors exposed to PAHs with deletion in GSTM1 gene (55.3% vs 66.9%, $p<0.003$ in the summer sampling). Our results illustrate, that application of X-rays dose to study DNA repair competence can be a good predictive biomarker in human monitoring studies. Obtained results imply that environmental exposure to polycyclic aromatic hydrocarbons via alteration of cellular DNA repair processes can result in effects harmful to human health. From our studies can be concluded that lowering of DNA repair efficacy increases amount of unrepaired DNA damage in lymphocytes of exposed to PAHs donors, that may elevate frequency of mutations and increase their risk of cancer.

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