CHRONIC EXPOSURE TO INDOOR RADON IN A HYDROTHERMAL AREA AND DNA DAMAGE IN ORAL EPITHELIAL CELLS

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Introduction

Radon is a naturally occurring radioactive gas, that is continuously released from soil diffuse degassing in hydrothermal areas (Baxter et al. 1999; Viveiros et al., 2009; Silva et al., 2015). As a gas ^{222}Rn is relatively harmless, but in contrast, radon decay emits radioactive particles that are deposited on the cells lining the airways, where they can damage DNA and potentially cause lung cancer (Sethi et al., 2012). The evidence available to date suggests that radon may be responsible for 3% to 15% of the lung cancer, making radon the second leading cause of lung cancer after tobacco smoke (Sethi et al., 2012), but the health risks of soil radon emissions in hydrothermal areas are yet poorly known. This cross sectional study was designed to evaluate the risk of DNA damage in the oral epithelial cells of individuals chronically exposed to indoor radon in a hydrothermal area located on the south flank of Furnas Volcano (Island of São Miguel, Azores, Portugal). The DNA damage in oral epithelial cells was measured by buccal micronucleus cytome assay (BMcyt) assay and by RAPD-PCR. The BMcyt assay is widely used to measure genetic damage, cell proliferation, cell differentiation and cell death in exfoliated buccal cells (Bolognesi et al. 2015). The random amplified polymorphic DNA (RAPD) analysis is a powerful PCR-based technique that involves the amplification of random segments of genomic DNA (De Wolf et al., 2004) and it has also been used as a biomarker for genotoxicity and carcinogenesis (Kumar & Gurusubramanian, 2011).

Methods

Oral epithelial cells were collected from 33 individuals (exposed group) inhabiting a hydrothermal area (Ribeira Quente village), and from 49 individuals (reference group) inhabiting a non-hydrothermal area (Ponta Delgada city). Information on life-style factors and an informed consent were obtained from each participant. For each individual, 1000 oral epithelial cells were analyzed for the frequency of micronucleated cells (MNC) and the frequency of cells with other nuclear anomalies (ONA: pyknosis, karyolysis and karyorrhexis) by using the micronucleus assay. DNA collected from exfoliated buccal cells was used for RAPD-PCR analysis. Indoor radon was assessed with Ramon 2.2 detectors. The relative risk of DNA damage was determined by Poisson regression model, adjusted for age, gender, smoking and drinking status.

Results

The frequency of MNC in the exposed group was significantly higher than in the reference group (3.1 ±0.2‰ vs. 1.9 ± 0.2‰, $p<0.001$), but for ONA no significant differences were observed (44.7 ±3.1‰ vs. 40.4 ± 3.2‰, $p=0.389$). Indoor radon concentration correlated positively with the frequency of MNC ($r_s=0.325$, $p=0.003$); the risk of having a high frequency of MNC was increased by 1.71 (95% CI, 1.2–2.4; $p=0.003$) in the exposed group, revealing that exposure to radon in the hydrothermal area is a risk factor of carcinogenesis. From the used three 10-mer primers, one displayed potential (F12) for detecting radon induced specific genomic alterations.

Conclusion

The buccal epithelial cells can be used as powerful endogenous matrix that reflects the effect of genotoxic and carcinogenic agents, and the BMcyt assay is an effective, fast, easy, and inexpensive biomarker when compared to RAPD-PCR. Results show a significant association between chronic exposure to indoor radon in hydrothermal areas and the occurrence of DNA damage in human oral epithelial cells. Since MNC in oral

epithelia are recognized as a predictive biomarker of cancer risk within a population of healthy subjects, the findings in this study evidence the carcinogenic potential of radon in hydrothermal areas.

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