

## Research Article

# Ionizing radiation induces epithelial–mesenchymal transition in human bronchial epithelial cells

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**Objective:** The present study aimed to analyze the mechanism by which long-term occupational exposure of workers to low-dose ionizing irradiation induces epithelial–mesenchymal transition (EMT) of the human bronchial epithelial cells using transcriptome profiling.

**Methods:** RNA-seq transcriptomics was used to determine gene expression in blood samples from radiation-exposed workers followed by bioinformatics analysis. Normal bronchial epithelial cells (16HBE) were irradiated for different durations and subjected to immunofluorescence, Western blotting, scratch healing, and adhesion assays to detect the progression of EMT and its underlying molecular mechanisms.

**Results:** Transcriptomics revealed that exposure to ionizing radiation led to changes in the expression of genes related to EMT, immune response, and migration. At increased cumulative doses, ionizing radiation-induced significant EMT, as evidenced by a gradual decrease in the expression of E-cadherin, increased vimentin, elevated migration ability, and decreased adhesion capability of 16HBE cells. The expression of fibronectin 1 (FN1) showed a gradual increase with the progression of EMT, and may be involved in EMT.

**Conclusion:** Ionizing radiation induces EMT. FN1 may be involved in the progression of EMT and could serve as a potential biomarker for this process.

## Introduction

People are inevitably exposed to ionizing irradiation in their daily lives and at work. The uncertainties about the health risks associated with long-term exposure to radiation at a low-dose in occupationally exposed workers have been the focus of research for many years. In their International Nuclear Workers Study (INWORKS), published in the International Journal of Epidemiology, in 2016, Hamra et al. specifically evaluated the radiation hazards and risk in a cohort of 600,000 nuclear workers in 15 countries [1]. Abbott A explored the risk of low-dose irradiation in 2015 [2]. Long-term general and occupational exposure to radiation has been the focus of research in the past. Keil et al. conducted a cohort mortality studies of underground miners from the Colorado Plateau [3]. Kamiya et al. conducted a cohort study of nuclear workers in U.S.A., and reported the ERR values of cancers and cardiovascular diseases in 2015 [4]. A recent epidemiological study emphasized the harmful effects of low-dose radiation exposure on human health and reported elevated cancer mortality among nuclear workers exposed to radiation at a cumulative dose <100 mSv and dose rate <10 mSv/year [5]. However, the biomarkers and molecular mechanism that predict the long-term and low-dose effect of radiation are not clear.

The carcinogenic effects of ionizing radiation rank first among other potential hazards of occupational exposure to radiation. It is of great clinical significance to detect and evaluate the carcinogenic role of radiation. In the early stages of exposure to radiation, several biological changes occur, of which epithelial–mesenchymal transition (EMT) is an important indicator of malignant change. EMT refers to

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