Examination of the effects of X-ray phase contrast imaging dose on DNA in mesenchymal stem cells by comet assay

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Keywords: DNA damage; monitoring

Hem. Ind. **78(1S)** 14 (2024)

Available on-line at the Journal web address: http://www.ache.org.rs/HI/

INTRODUCTION: Imaging techniques based on X-ray phase-contrast (XPC) have shown tremendous promise for applications involving biomaterials and soft tissue formation [1,2]. XPC imaging can be applied at higher energy offering the potential for lower dose imaging. Essential to the development of this technique and its routine use is an understanding of the potential damage of X-ray dose on cells and tissues.

EXPERIMENTAL: In this study the comet assay, a sensitive assay for DNA damage, was used to evaluate DNA damage on mesenchymal stem cells (MSCs) exposed to X-ray irradiation. We examined the effects of early (immediately following irradiation) and delayed (24 h post-irradiation) X-ray effects caused by low (15 mGy) and intermediate (150 mGy and 1.5 Gy) exposure on MSCs during a monitoring period of 4 weeks (five irradiations, one weekly). Cells were submitted to a polychromatic X-ray source (Thermo Fisher PXS10 conditions: voltage 45 kV, source current 160 μA, source power 7.2 W, source spot size 9 um, photon flux on the sample 7.66 10^6 photons s^{-1} mm^{-2} irradiation).

Statistical analysis was performed by using Two-way analysis of variance (ANOVA) with Tukey's multiple comparisons posttest in GraphPad Prism 5.0.A difference at $p < 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION: Results of the DNA comet assay indicated that early effects of low- and intermediate-dose of XPC induced an increase in the number of cells with DNA damage after each irradiation, where intermediate-dose (150 mGy and 1.5 Gy) produced significantly higher damage relative to controls. DNA damage induced by low and intermediate doses returned to the control value 24 h after the irradiation exposure, suggesting a strong protection of MSCs at the tested doses of XPC irradiation.

CONCLUSIONS: The data presented in this study shows that 24 h after the last of five weekly low and intermediate doses XPC irradiation, the harmful effects on DNA in MSCs were not detected. The current study reinforces the need of investigating consequences of low and intermediate doses of X-ray PC irradiation in the field of tissue engineering and provide new basis for MSCs using in the clinics.

Acknowledgements: This investigation is the result of work carried out during Fulbright Fellowship Programme.

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