In vitro survival of MCF-7 breast cancer cells following combined treatment with ionizing radiation and mitoxantrone-mediated photodynamic therapy

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Summary This study evaluated the effects of mitoxantrone (MX) as a sensitizer following combined treatment with ionizing radiation and photodynamic therapy in the MCF-7 human breast cancer cell line. Cells were incubated with MX at different concentrations for 90 min and exposed to different fluence rates of non-coherent light and different dose rates of ionizing X-ray radiation in independent treatment groups. Additionally, the combined effects of chemotherapy, phototherapy, and radiotherapy were evaluated. The percent cell survival was investigated using the MTT assay. MX acted as both a photosensitizer and radiosensitizer. Furthermore, the use of 1 \textmu M MX in combination with PDT at 10 J/cm\textsuperscript{2} and 4 Gy of X-ray radiation strongly resulted in the death of cancer cells and reduced the percentage of viable cancer cells to 2.4±1.15. Our data demonstrated that the adverse effects of MX in combination with radiotherapy were partially abated, without a reduction in the efficacy of treatment. This new therapeutic avenue for breast cancer therapy merits further investigation using in vivo models for application in humans.

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Introduction

Cancer is currently one of the most devastating diseases [1]. Worldwide, among women, breast cancer is the most common cause of cancer mortality [2]. A United States Food and Drug Administration (US-FDA)-approved approach for the treatment of different human cancers is photodynamic therapy (PDT) [3–7]. PDT is believed to act through cytotoxic singlet oxygen (reactive oxygen species [ROS]). PDT is a treatment modality that utilizes ROS overproduction. PDT involves the selective accumulation of sensitizers by the target cells and subsequent irradiation with light in the range of the absorption maxima of the sensitizer. Upon absorption, the sensitizer is excited into a high-energy state from which it returns, accompanied by the transfer of an electron to