Nanomaterial regulates the radiosensitivity in colorectal cancer cells

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Introduction: Colorectal cancer (CRC) is a common gastrointestinal malignant tumor with high rate of postoperative recurrence. And the risk of metastasis of CRC is still one of the main reasons for the failure of CRC treatments. Radiation therapy is a commonly method to treat CRC, which occupies an irreplaceable important position in surgery, chemotherapy and other treatments. Metal-based nanomaterial was deemed as one of the radio sensitivity agent due to atom effect.

Objective: To improve the effects of irradiation on tumor cells, we testified the effect of Graphene Quantum Dots (GQDs) with good biocompatibility and rich oxygen groups on radio sensitivity. Meanwhile, we investigated the radio sensitivity mechanism of GQDs. Our study would provide reliable experimental basis for GQDs as a radiotherapy sensitization agent in potential clinical applications.

Contents & Methods: The GQDs were prepared with graphene oxide (GO) and the safe concentration of GQDs were determined by CCK8 assay, laser confocal microscope and transmission electron microscopy are carried out to measure the sub-cellular localization of GQDs, the proliferation ability of different treated groups were detected by performing CCK8 assay and colony formation assay, the cell apoptosis rate and the cell cycle arrest of treated groups were detected by Flow Cytometry, the cell damage was observed by transmission electron microscopy, the production of ROS and mitochondrial ROS in treated groups were measured by DCFH-DA and MITOSOX Red Indicator, respectively, the expression of γH2AX which reflect the degree of DNA double-strand breaks was detected by western blot after different treatments.

Results: The safety concentration of GQDs on SW620 and HCT116 cells was 50 μg/mL. Transmission electron microscopy and laser confocal microscope revealed that GQDs were mainly distributed in cytoplasm of cells. In addition, our study indicated that GQDs could decrease the cell viability, increase the degree of cell damage and cell apoptosis of SW620 and HCT116 cells under the irradiation synergistic effects. Meanwhile, with the synergistic effects of ionizing radiation, GQDs could enhance intracellular ROS generation of SW620 and HCT116, and increased the ROS levels in mitochondria which increase DNA double-strand break out and G2/M phase cell cycle arrest cells.

Conclusions: This study demonstrated that GQDs have good radio sensitivity at cell levels *in vitro*, which can improve the killing effects of irradiation on tumor cells, and ultimately achieving treating cancer. It illustrates that GQDs present great potentials in tumor therapy as a new type of radio sensitivity agent. In this seminar, I will discuss the protocol we developed to pattern the first human hNT neurons on parylene-C/ SiO2 substrates and how, in our more recent work, we have patterned the first hNT astrocyte, on such substrates to single cell resolution.

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