**X-ray assisted photodynamic therapy for pancreatic cancer**

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Conventional treatments for cancer, such as chemotherapy, radiotherapy, and surgical resection, have shown limited healing efficacy and may cause severe side effects, poor targeting, and drug resilience for monotherapies, which strongly restrict their clinical application. Thus, various combinatorial strategies, such as photodynamic therapy (PDT), are investigated in detail to combat cancer. PDT [1] is a controllable, non-invasive, and non-cumulative two-step treatment that combines a nontoxic and biocompatible photosensitiser (PS), oxygen, and light to annihilate tumour cells and tissues. Upon light activation, the PS generates reactive oxygen species (ROS), which selectively destroy the targeted malignant tissue.

Deep-seated tumours, such as those in the lungs, pancreas, ovaries, colorectum, and kidneys, are challenging to treat with PDT because visible or near-infrared light has a tissue penetration depth of less than 3 cm, thus limiting PDT treatment to superficial tissues. This obstacle may be eliminated by X-PDT, a PDT based on X-ray irradiation, which penetrates deeper than visible or infrared light [2]. X-PDT utilises a scintillator (e.g., lanthanides) to convert external X-ray photons into visible light photons, which in turn activate the PS to trigger PDT-mediated processes within the tumour tissue.

Pancreatic cancer is among the most deadly forms of cancer globally, with one of the lowest survival rates. In this work, we experimentally examined the viability of MIA PaCa-2 pancreatic cancer cells as a function of the concentration of the photosensitive molecule protoporphyrin IX doped with a rare-earth element, Gd (pPIXGd). For the concentration range from 1.56 µg/mL to 50 µg/mL, the minimal cell viability was 43%. In parallel, we explore the *in-vitro* viability of MIA PaCa-2 cells under irradiation with X-rays of different doses (from 0.5 to 6 Gy). Finally, we combine a concentration of pPIXGd that exhibits low cytotoxicity (the mortality rate ≈ 26%) with the lowest X-ray dose, which weakly kills cancer cells (the mortality rate ≈ 11%), and observe a notable synergistic effect, resulting in total cell viability reduced to ≈ 51%.

REFERENCES

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