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Photodynamic and sonodynamic therapy synergy: mechanistic insights and cellular responses against glioblastoma multiforme

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Abstract

Glioblastoma multiforme (GBM), the most aggressive form of brain cancer, poses substantial challenges to effective treatment due to its complex and infiltrative nature, making it difficult to manage. Photodynamic therapy (PDT) and sonodynamic therapy (SDT), have emerged as promising individual treatment options against GBM due to their least-invasive approach. However, both PDT and SDT have drawbacks that require careful consideration. A combination therapy using light and sound waves has gained attention, offering new avenues to overcome challenges from individual therapies. Sono-photodynamic therapy (SPDT) has been used against various tumours. Researchers are considering SPDT as a favourable alternative to the conventional therapies for GBM. SPDT offers complementary mechanisms of action, including the production of ROS, disruption of cellular structures, and induction of apoptosis, leading to enhanced tumour cell death. This review gives an insight about PDT/SDT and their limitations in GBM treatment and the need for combination therapy. We try to unveil the process of SPDT and explore the mechanism behind improved SPDT-meditated cell death in GBM cells by focusing on the ROS-mediated cell response occurring as a result of SPDT and discussing current modifications in the existing sensitisers for their optimal use in SPDT for GBM therapy.

Keywords: Future of SPDT; Glioblastoma multiforme; reactive oxygen species; sensitizers; sono-photodynamic therapy.