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Immunotherapy: Open Access

Editorial

Recent Trends in Photoimmunotherapy

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EDITORIAL NOTE

Photoimmunotherapy (PIT) is an oncological treatment that combines tumour photodynamic therapy with immunotherapy. Combining photodynamic therapy with immunotherapy boosts the immune system's response and provides synergistic effects in the treatment of metastatic cancer. PIT is a sort of molecular targeted cancer therapy that permits cancer cells to be selectively destroyed while causing no harm to healthy organs. Professor Julia Levy and colleagues at the University of British Columbia, Canada, developed and pioneered this light-based cancer therapy in 1983.

Professor Julia Levy's study was also instrumental in the approval of Visudyne and Photofrin in clinical trials. PIT has been researched extensively in vitro and in vivo by several research teams all around the world over the last 35 years. Professor Kobayashi and his colleagues at the National Cancer Institute in Bethesda, Maryland, have lately made substantial advances in PIT. Traditional photodynamic therapy (PDT) kills cancer cells by activating a non-specific photosensitizer with non-ionizing light. When cells are exposed to light at a specific wavelength, photosensitizers produce reactive oxygen species (ROS) that swiftly kill them. However, because non-targeted photosensitizers are also taken up by normal tissues, this PDT treatment has substantial adverse effects.

PIT therapy prevents side effects by using a targeted-photosensitizer, which consists of two parts: a monoclonal antibody (mAb) that detects specific proteins on the surface of cancer cells and a non-targeted photosensitizer. Despite the fact that the novel mAb-based photosensitizers are widely disseminated, they can only be activated by light for targeted PIT when linked to specific proteins on cancer cells membranes.

PIT has previously been demonstrated to work with a wide range of photosensitizers, including porphyrins, chlorins, and phthalocyanine dyes. Professor Kobayashi's team combined anti-tumor antibodies that target human epidermal growth factor receptors with IRDye 700DX, a water-soluble phthalocyanine dye that is triggered by near-infrared light.IRDye 700DX was chosen because of its hydrophilicity and the significant cytotoxicity it produces when it binds to the cellular membrane and is activated. Epidermal growth factor receptors are overexpressed in a range of malignancies, including breast and pancreatic tumours. "mAb-IR700 conjugates" was the name given to this new photosensitizing chemical based on the IRDye 700DX NHS Ester.

In vitro tests revealed that mAb-IR700 destroyed tumour cells seconds after exposure to near-infrared light. There was also a link between the intensity of the excitation light and the percentage of cells that died. Normal cells were not damaged by infrared light or the mAb-IR700 conjugate alone. Significant tumour reduction was found in tumor-xenografted mice treated with mAb-IR700 with near-infrared light. Eighty percent of tumour cells were eliminated and the mice's life was greatly prolonged after fractionated delivery of mAB–IR700 compound followed by systematic repetitive NIR light irradiation to the tumour. According to the current theory, PIT-induced cell death was produced by the rapid expansion of local water as a result of the creation of holes in the membrane.Another advantage of PIT based on the mAb-IR700 conjugation is that it generates fluorescence light when activated. As a result, mAb-IR700 can be given at a reduced dose before PIT to help guide the delivery of excitation light to tumour tissues, reducing excessive light exposure to surrounding tissues.

PIT is a promising, highly selective, and clinically practical treatment for mAb-binding cancers with low off-target consequences. In the future, researchers hope to conjugate phthalocyanine to a range of different monoclonal antibodies, resulting in a very adaptable therapeutic platform.

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Received: May 05, 2021; **Accepted:** May 19, 2021; **Published**: May 26, 2021

Citation: Zhang H (2021) Recent Trends in Photoimmunotherapy. Immunotherapy (Los Angel). S1:e001.