Department of Biomedical Sciences
香港城市大學
City University of Hong Kong

Engineering Photodynamics for Cancer Treatment, Priming, and Imaging

Abstract:

Photodynamic therapy (PDT) is a clinically approved, light-activated treatment that uses red light to trigger photosensitizers, which generate reactive oxygen species to kill cancer cells. These activated photosensitizers also emit fluorescence, enabling simultaneous imaging and therapeutic monitoring. This presentation will provide an overview of the fundamental mechanisms of PDT and its clinical and preclinical applications, including fluorescence-guided tumor ablation, tumor vasculature permeabilization, strategies to overcome multidrug resistance, and photochemical drug release. We will discuss how nano- and molecular-engineering strategies are used to improve the pharmacokinetic and pharmacodynamic profiles of photosensitizers, as well as their tumor-targeting specificity—particularly in glioblastoma and ovarian cancer models. Recent advances from our lab include a surfactant-free method for producing amorphous nanosuspensions of photosensitizers for glioblastoma PDT. These nanosuspensions become photoactive after being internalized by cancer cells, enabling both therapeutic action and real-time fluorescence imaging. In preclinical studies, this approach resulted in up to a 10-fold improvement in anti-cancer efficacy compared to current clinical photosensitizer formulations. For peritoneal ovarian carcinomatosis, we developed a targeted nanoplatform that co-delivers PDT agents and chemotherapy. This system takes advantage of molecular changes induced by peritoneal fluid shear stress, achieving an optimal balance between selectivity and cellular uptake. The result is a multi-tiered targeting strategy that enhances therapeutic efficacy and safety in vivo. Overall, this presentation will highlight the promise of light-activatable nanoplatforms in advancing PDT into a precise, multimodal approach for treating both primary and metastatic cancers.

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Huang-Chiao (Joe) Huang is the Fischell Family Distinguished Professor and an Associate Professor of Bioengineering at the University of Maryland, College Park, USA. He earned his Ph.D. in Chemical Engineering from Arizona State University and completed a postdoctoral fellowship in photomedicine at Harvard Medical School. Dr. Huang leads a photomedicine and translational cancer research program supported by the NSF, NIH, private foundations, and industry partners. His research focuses on developing photodynamic therapy and light-activatable nanotechnologies for disease detection and treatment. He has received numerous honors, including the prestige NIH Pathway to Independence Award and the NIH NIBIB Trailblazer Award. Dr. Huang also serves as an elected member of the Board of Councilors for the American Society for Photobiology.

2:00 pm - 3:00 pm, 18 June 2025 (Wednesday)

P4703, 4/F, Yeung Kin Man Acad Building, CityU HK