

One step ahead: light-based combinations to combat treatment resistance in cancers

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Resistance of cancer cells to treatment is multifactorial and may be inherent or acquired. Treatment resistance can be broken down into two broad categories. The first results from changes within cancer cells that prevent drugs from being able to do damage through a variety of mechanisms such as enhanced drug efflux or inhibition of cellular repair machinery. The second arises from the activation of survival signaling pathways after sub-optimal therapy that regulate cell growth and proliferation, thus creating additional challenges in the destruction of cancer cells. Because these mechanisms of treatment resistance lead to poor outcomes for patients, innovative and intelligently-engineered strategies are urgently needed to overcome them. Owing to their unique mechanisms of action and cytotoxicity, phototherapies (*e.g.* photodynamic therapy, photothermal therapy) may have a specific role in overcoming drug resistance by the targeted destruction of specific survival pathways and re-sensitizing cancer cells to conventional chemotherapy and radiation. Guided by a mechanistic understanding of the biological pathways, as well as the capabilities allowed by creative chemical and nanoscale engineering, multi-agent delivery and other nanoengineering-based methods can be employed to inhibit multiple pathways and activate death mechanisms to enhance tumor control, improve survival rates, and reduce side-effects. Results from chemical engineering-based approaches to rationally-designed therapies, with a particular emphasis on addressing compensatory tumorigenic pathways and an eye towards clinical translatability, will be discussed in the context of developing a forward-looking research direction in image-guided nano-photomedicine.

SEMINAR
Monday, February 8th
4:00 - 5:00 pm
LMC 101