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Nanoliposomes in Photothermal Therapy: Advancements and Applications

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Abstract : Nanoliposomes, minute lipid-based vesicles at the nano-scale, show promise in the realm of photothermal therapy (PTT). This study presents an extensive overview of nanoliposomes in PTT, exploring their distinct attributes and the significant progress in this therapeutic methodology. The research delves into the fundamental traits of nanoliposomes, emphasizing their adaptability, compatibility with biological systems, and their capacity to encapsulate diverse therapeutic substances. Specifically, it examines the integration of light-absorbing materials, like gold nanoparticles or organic dyes, into nanoliposomal formulations, enabling their efficacy as proficient agents for photothermal treatment Additionally, this paper elucidates the mechanisms involved in nanoliposome-mediated PTT, highlighting their capability to convert light energy into localized heat, facilitating the precise targeting of diseased cells or tissues. This precise regulation of light absorption and heat generation by nanoliposomes presents a non-invasive and precisely focused therapeutic approach, particularly in conditions like cancer. The study explores advancements in nanoliposomal formulations aimed at optimizing PTT outcomes. These advancements include strategies for improved stability, enhanced drug loading, and the targeted delivery of therapeutic agents to specific cells or tissues. Furthermore, the paper discusses multifunctional nanoliposomal systems, integrating imaging components or targeting elements for real-time monitoring and improved accuracy in PTT. Moreover, the review highlights recent preclinical and clinical trials showcasing the effectiveness and safety of nanoliposome-based PTT across various disease models. It also addresses challenges in clinical implementation, such as scalability, regulatory considerations, and long-term safety assessments. In conclusion, this paper underscores the substantial potential of nanoliposomes in advancing PTT as a promising therapeutic approach. Their distinctive characteristics, combined with their precise ability to convert light into heat, offer a tailored and efficient method for treating targeted diseases. The encouraging outcomes from preclinical studies pave the way for further exploration and potential clinical applications of nanoliposome-based PTT.

Keywords : nanoliposomes, photothermal therapy, light absorption, heat conversion, therapeutic agents, targeted delivery, cancer therapy
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