Wireless LED-activated drug delivery system for cancer treatment

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Metronomic photodynamic (mPDT) therapy has drawn more and more attention from researchers in recent years. As it generally replies on implantation of tiny and wirelessly powered light source, the limitation of light penetration in tissues can be overcome[1]. Moreover, featuring long-term and low-irradiance irradiation, mPDT shows advantages of ignorable burning damage on tissues[2]. Here we report a novel photoresponsive drug delivery system (BTNPs), which can be triggered by green light at 530 nm. The nanoparticles consist of two parts: synthesized photoactivatable trigonal molecule BTAEA and amphiphilic stabilizer molecule DSPE-mPEG. Cytotoxicity test showed significant in vitro antitumor efficacy of BTNPs triggered by either common LED (50 mW/cm^2, 2 min) or micro-LED (0.4 mW/cm^2, 4 hrs). PDT effect was verified by detected generation of reactive oxygen species both intracellularly and extracellularly. Furthermore, a biocompatible PDMS film (around 60 μm) has been prepared for packing and implantation of micro-LED, which can be wirelessly powered by RFID antenna. In summary, we successfully fabricated a novel drug delivery system and applied it for mPDT. We demonstrated the micro-LED could efficiently trigger mPDT and display similar anti-tumor efficacy compared with common LED light, which provides solid base for its preclinical and clinical applications.

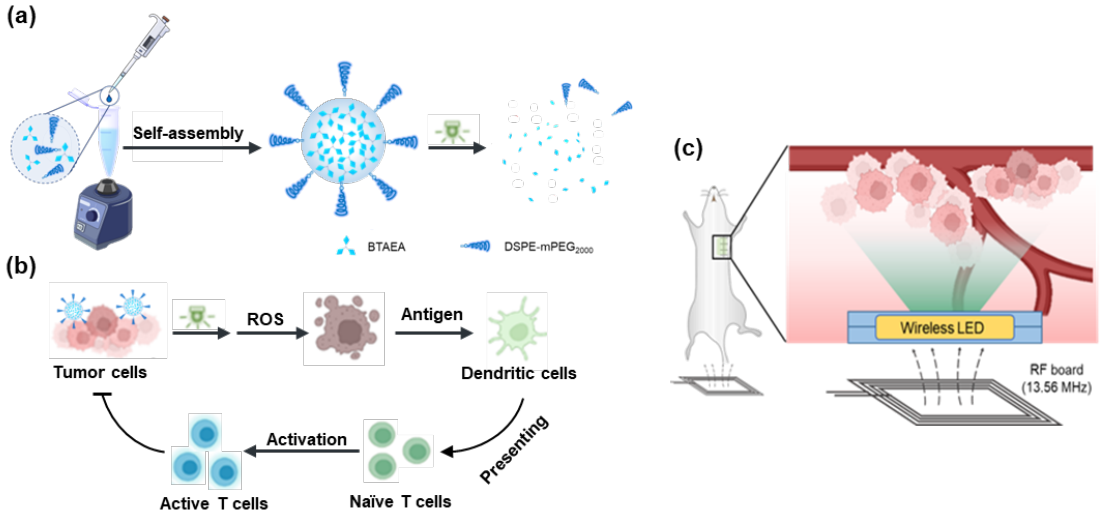

Figure 1: (a) Fabrication of the photoresponsive drug delivery system by a self-assembling method. The nanoparticles can disassemble under green light-irradiation (530 nm). (b) Function mechanism of BTNPs. Under green-light irradiation, BTNPs can induce tumour immunogenic cell death (ICD) and downstream immune reaction through mPDT. (c) Schematic illustration of the application of implanted micro-LED. The implanted micro-LED can be wirelessly charged as light source at tumour sites by RFID at 13.56 MHz.

References:

1. Borgia, F. et al. *Biomedicines* **2018**, *6, (1), 12*.
2. Yamagishi, K. et al. *Nat Biomed Eng* **2019**, *3*, 27–36.