Abstract

Photodynamic therapy, a non-invasive cancer treatment strategy, is one of the promising remedies for malignant skin cancers. This therapy provides many advantages; high accuracy, minimal invasiveness, availability of multiple irradiations at the same area, no long-term side effects, and high cost-performance. Treating skin cancer with this method, it is essential to permeate sufficient photosensitizer molecules into cancer cells before shining light for effective activation of photosensitizers in a tumor to express potent reactive oxygen species, such as superoxide (O_2^-), hydroxyl radical ($OH^\bullet$), singlet oxygen, and hydrogen peroxide (H_2O_2), for eradicating cancer cells. However, transdermal drug delivery using conventional photosensitizers has major challenges due to skin barriers, resulting in less effective drug penetration and therapeutic efficacies. To overcome these limitations, we applied biocompatible, physiologically dissolvable, and optically activatable functional microneedle devices for effective percutaneous penetration of drug molecules into the solid tumor under the skin of a mouse. One of the additional disadvantages of photodynamic therapy is the powerful laser light needed to activate the photosensitizer. After undergoing laser therapy, patients frequently experience skin burns, inflammation, edema, and redness due to the strong laser light energy. Herein, we considered wireless LED light-induced functional microneedle devices, effectively induce cancer cell apoptosis and disruption of the tumor area, could enhance *in vitro*, *ex vivo*, and *in vivo* drug delivery effectiveness for skin cancer treatment. The design and strategy of the present functional microneedle devices would help shed light on future advanced cancer therapy.

Keywords: skin cancer, dissolvable microneedles, light-emitting diode, photodynamic therapy, chemotherapy