Editorial

Nanozyme: New Horizons for Cancer Therapy

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Nanocatalytic medicine has attracted considerable interest in recent years as it is progressively being explored in cancer diagnosis and treatment, inflammation, infectious diseases, and degenerative disease.[1-4] The concept of nanocatalytic medicine is centered on exploiting nanocatalysts to resolve medical problems.[1,5,6] Catalytic therapies have greatly benefited the growing field of nanomedicine as they have provided effective strategies for tumor therapy, antibacterial therapy, and anti-inflammatory therapy.[1,2]

Nanocatalytic medicine has recently been recommended for tumor therapy.[1,7,8] It is mainly based on generation of toxic species by intratumoral catalytic chemical reactions from non-/less toxic substances. This has opened up a new paradigm for cancer treatment as it enables tumor-specific therapy with no significant side effects.[9] The reactants in these catalytic reactions are typically the inherent biochemicals in pathological regions and not the delivered therapeutic agents, thus conferring high specificity for alleviating side effects. Of the various strategies involved in nanocatalytic tumor therapeutics, reactive oxygen species (ROS)-based nanocatalytic therapies, using catalytic nanomaterials with enzyme-like activity (nanozymes), have demonstrated potential for reducing side effects in cancer treatments.[9] The term nanozyme was coined to represent a new class of nanomaterials that mimic the catalytic activity of natural enzymes in the complex biological environment of the human body.[5,9] The biocatalytic activities of some common enzymes such as peroxidase, catalase, superoxide dismutase, oxidase, and phosphatase have been mimicked by the nanomaterials.[10] Nanozymes exhibit several advantages over natural enzymes, such as high stability, ease of synthesis, recyclability, tunable catalytic activity, and applicability to various health problems.[11] Nanozymes have significant potential as efficient therapeutic agents for cancer remediation. They have capability to modulate intracellular and extracellular redox levels, induce ROS including hydroxyl radicals (OH), singlet oxygen ($^1O_2$), and superoxide radicals (O_2^-), thereby directly killing tumor cells.[12,13] Although nanozyme-based cancer therapies have promising futures, they are still in the initial stages of development. Most of the research been conducted are in vitro but there are no reports on clinical trials yet. However, in vivo experiments are growing in animal models. Furthermore, fundamental issues such as the influence of nanozymes' size and morphology of on cellular uptake, long-term toxicity, surface fouling, and the effect of biological fluids on the stability of nanozymes still requires extensive investigation.[14] Another gap between current research and clinical trials that is preclinical studies, for example, pharmacokinetics studies to assess biodistribution, metabolism, clearance, and excretion.[15]

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