Recent Development on Fullerene-based Nano-PDT Drugs for Photo-inactivation of Infectious Bacteria and Cancer Cells

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Photosensitizing drugs operate via the generation of reactive oxygen species (ROS) upon illumination in situ and this allows non-specific attack, e.g. by singlet oxygen ($^1O_2$) or superoxide radicals ($O_2^{-}\cdot$), at the cell level. The lack of any demonstrated microbial resistance mechanism toward ROS allows its use against a wide range of bacteria, viruses, yeasts, and protozoa by killing these pathogens in the infection. Local administration of the PS into the infected area allows pathogen destruction without undue damage to the surrounding host tissue. The relentless world-wide increase in multi-antibiotic resistance particularly amongst bacteria, has necessitated the search for alternative antimicrobial techniques. Therefore, antimicrobial PDT may be a new broad-spectrum microbiocide on where the infecting pathogens are localized to a specific anatomical location such as skin, wounds and burns, abscesses, oral cavity, sinuses, ear canal, stomach, bladder, etc.

New hydrophilic fullerenyl photosensitizers (FPS) exhibit high efficiency in ROS production that leads us to propose their broad-spectrum cytotoxic activity upon illumination against microbial pathogens and tumor cells regardless of conventional drug-resistance status, e.g. against methicillin-resistant SA (MRSA) or vancomycin-resistant SA (VRSA). In addition, ROS produced by PDT was shown to kill tumor cells regardless of their responsiveness to traditional chemotherapy drugs or ionizing radiation and induce no intrinsic resistance upon repeated PDT treatments.

It is our essential interest to develop and enhance the mechanism of more effective Type-I photochemistry for PDT via the structural modification of fullerenes. The detailed experiments will be discussed.