Tetrapyrrolic photosensitizers in the development of protocols for safe blood disinfection

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Blood transfusion is a life-saver medical procedure used worldwide. Although several advances were made towards an improvement in transfusion security, microbial infections transmitted through blood products transfusion still occur, causing disease in the recipient. Conventional blood disinfection techniques, considered safe for plasma, are usually associated with collateral damages on concentrated platelets and erythrocytes. Alternative methods are required and antimicrobial PhotoDynamic Therapy (aPDT) has been suggested as an alternative technique to blood disinfection. aPDT is based on the interaction of a photosensitizer (PS) agent, light and molecular oxygen which results in the production of reactive oxygen species (ROS) that cause biomolecular damage leading to microbial death. Methylene blue, psoralen and riboflavin are already approved PS in some countries to disinfect plasma. However, there is no aPDT-approved application for concentrated platelets and erythrocytes.

In the last years, others PS are being considered for blood disinfection namely tetrapyrrolic macrocycles such as porphyrins (Por) and the analogues phthalocyanines (Pc). Pc and Por derivatives show interesting features especially strong visible light interaction, good ROS production and effectiveness in the photoinactivation of viruses, mainly enveloped ones such as HIV, and bacteria, even those resistant to antibiotics. Focused to find efficient PS agents to blood disinfection the octa-substituted methoxypyridinium phthalocyanine $Zn(MeOPy^{+})_8Pc$ (bearing eight positive charges) and the tri-substituted pyridinium porphyrin Tri-Py^{+}-Me-PF (bearing three positive charges), developed in our group, were used to evaluate their suitability to photoinactivate bacteria present in contaminated blood products (plasma and whole blood). Effective reduction of Gram-positive and Gram-negative bacteria in contaminated blood samples were attained using porphyrin Tri-Py^{+}-Me-PF with no significant osmotic stress. These results show that aPDT with the tri-cationic porphyrin can be a promising alternative method to disinfect blood.