Universidade de São Paulo
Instituto de Física de São Carlos

XIV Semana Integrada do Instituto de Física de São Carlos

Livro de Resumos da Pós-Graduação

São Carlos
2024

Ficha catalográfica elaborada pelo Serviço de Informação do IFSC

Semana Integrada do Instituto de Física de São Carlos
(13: 21-25 ago.: 2023: São Carlos, SP.)
Livro de resumos da XIII Semana Integrada do Instituto de Física de São Carlos – Universidade de São Paulo / Organizado por Adonai Hilário da Silva [et al.]. São Carlos: IFSC, 2023.
358p.

Texto em português.
1.Física. I. Silva, Adonai Hilário da, org. II. Título.

ISSN: 2965-7679

123

Use of antimicrobial photodynamic therapy enhanced by reactive Iodine species against *S. pneumoniae In vitro*

KURACHI, Cristina[1]; JASINEVICIUS, Gabriel Oliveira[1]; GUIMARÃES, Francisco Eduardo Gontijo[2]

gabriel.jasine@ifsc.usp.br

[2]Instituto de Física de São Carlos - USP

Pneumonia is a major global health concern, particularly among vulnerable populations such as young children and the elderly, responsible for approximately 2.5 million deaths annually worldwide. (1) Additionally, the rise of bacterial antibiotic resistance makes it increasingly difficult to treat, highlighting the need to explore alternative treatments. Photodynamic therapy (PDT) has emerged as a promising candidate. PDT utilizes light-activated photosensitizers to generate short-lived reactive oxygen species (ROS) and is employed to eliminate pathogens and cancer cells. Methylene Blue (MB) is a photosensitizer with favorable characteristics for antimicrobial PDT (aPDT), including its absorption in the red light spectrum, resulting in an increased response at the tissue depth, and a high singlet oxygen quantum yield. (2) Moreover, combining MB with Potassium Iodide (KI) has shown to significantly enhance aPDT efficacy by generating reactive iodine species (RIS). RIS demonstrate prolonged antimicrobial activity by forming both short-lived ($I\cdot$ or I_2^-) and stable species (I_2/I_3^-), leading to sustained pathogen damage. (3) This study investigated the bactericidal effects of MB-KI aPDT and its photoproducts against *S. pneumoniae*, a common pneumonia bacterial agent. In planktonic aPDT *in vitro* tests using *S. pneumoniae* in solution containing PBS and 5% lung surfactant (Survanta), MB-KI aPDT (MB = 10 µM; KI = 50 mM) using 660 nm LEDs with a light dose of 36 J/cm² achieved a complete 5-log reduction in colony-forming units (CFUs). This result surpassed the efficacy of MB aPDT (MB = 10 µM), which achieved approximately a 4-log reduction. Additionally, the photoproducts of the MB-KI combination, incubated for 10 minutes in the bacterial mix, achieved approximately a 3-log CFU reduction. Furthermore, using a lung alveolar transwell model, this study assessed the impact of naturally produced lung surfactant by a co-culture of lung epithelial cells (A549) and endothelial cells (HUVEC). Treatments were performed with the same parameters as the planktonic assay. While MB aPDT alone showed reduced efficacy in the presence of lung surfactant, likely due to molecular interactions, both MB-KI aPDT and its photoproducts maintained consistent antimicrobial activity. This finding emphasizes the potential of the MB-KI combination to overcome challenges in the lung microenvironment. To assess cytotoxic effects in the transwell treatment groups, confocal images were obtained using a Live/Dead cell stainer (Acridine Orange/Ethidium Bromide). Analysis revealed that while MB aPDT and MB-KI aPDT induced varying degrees of cell death in both endothelial and lung epithelial cells, the use of photoproducts incubated for 10 minutes showed no signs of cell damage. This suggests that when performing the aPDT, the mammalian cells are also damaged, without any selective response, but when treating only with the photoproducts, it may be possible to achieve a safe protocol for the host cells. In conclusion, this study demonstrates the potential of the photoproducts of MB-KI PDT as a promising treatment strategy for *S. pneumoniae*. The combination's enhanced efficacy, ability to overcome surfactant interference, and reduced cytotoxicity of its photoproducts could support further investigation as a potential therapeutic approach.

Palavras-chave: Reactive iodine species; aPDT; S. Pneumoniae

Agência de fomento: CNPq (140537/2022-8)

Referências:

1 LÜTHI-CORRIDORI, G. *et al.* Predictors of length of stay, rehospitalization and mortality in community-acquired pneumonia patients: a retrospective cohort study **Journal of Clinical Medicine**, v. 12, p. 1-15, 2023.

2 TARDIVO, J. P. *et al.* Methylene blue in photodynamic therapy: from basic mechanisms to clinical applications **Photodiagnosis and Photodynamic Therapy**, v. 2, p. 175–191, 2005.

3 HAMBLIN, M. R.; ABRAHAMSE, H. Inorganic salts and antimicrobial photodynamic therapy: mechanistic conundrums? **Molecules**, v. 2, p. 1-18, 2018.