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In vitro target delivery and photodynamic therapy with polyelectrolyte microcapsules loaded with chlorin e6 and iron oxide nanoparticles

Ekaterina Brodovskaya[1], Denis Yakobson[1], Larisa Tararina[2], Mikhail Zharkov[1], Vasilisa Shlyapkina[1], Irina Khutorskaya[1], Amina Al-khadj Aioub[1], Nikolay Pyataev[1]

[1]**National Research Ogarev Mordovia State University, Saransk, Russia**

[2]A.I.Yevdokimov Moscow State University of Medicine and Dentistry, Moscow, Russia

INTRODUCTION & AIM

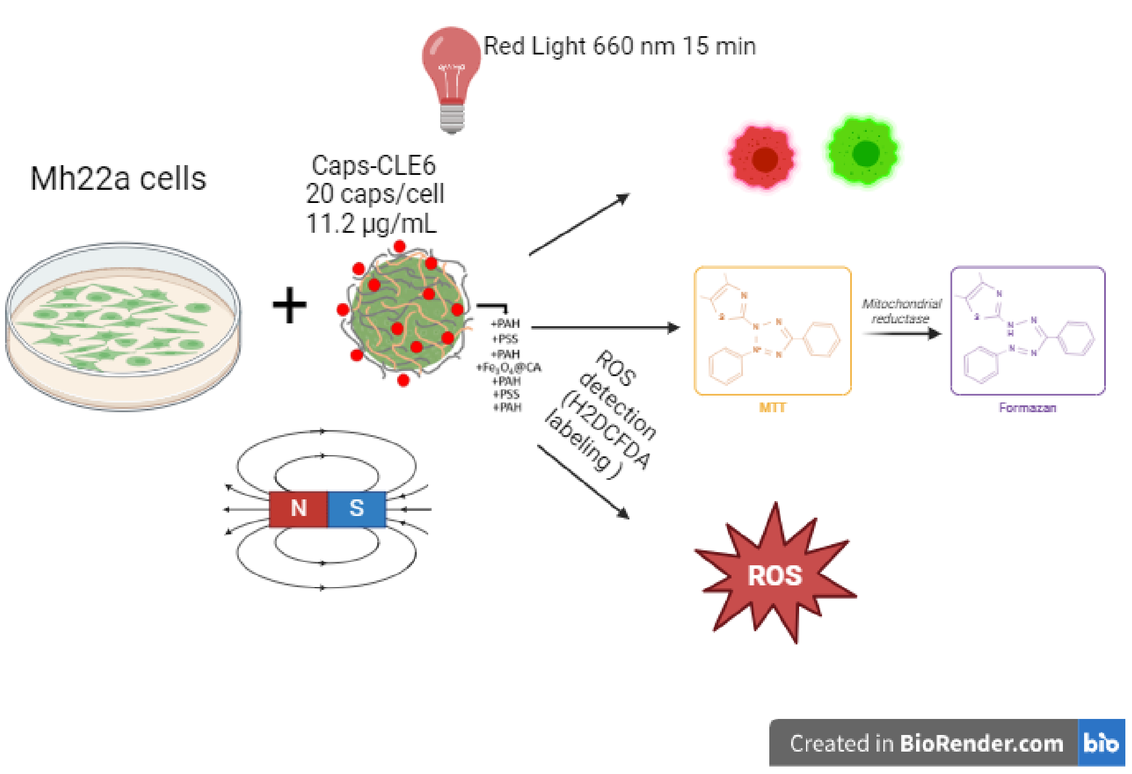
Photodynamic therapy (PDT) is a photochemistry-involved treatment process that uses different photosensitizers to generate cytotoxic reactive oxygen species (ROS) under light activation, thus causing cell apoptosis and necrosis and tissue destruction [1]. PDT has some advantages over other methods of oncology treatment such as minimal toxicity to normal tissues or organs because the generation of ROS is a light-triggered process and photosensitizers are usually not toxic in the dark [2]. As a photosensitizer (PS) for PDT, chlorin E6 (CLE6) is widely used, which under the action of a laser or LED lamp (wavelength 660±5 nm). To overcome the challenges of poor solubility, low permeability, and tendency for aggregation of PS, suitable drug delivery systems need to be prepared. Specially designed polymeric drug delivery systems encapsulate the drug within the core and increase the stability, solubility and permeability of the loaded PS [2].

The goal of the research was to investigate photocytotoxicity effect and target delivery of polyelectrolyte microcapsules loaded with the chlorin E6 and iron oxide nanoparticles on mouse hepatoma cells (Mh22a).

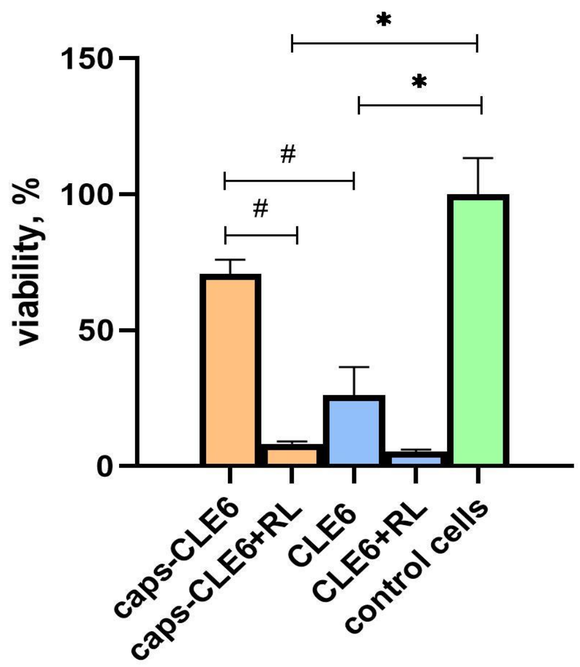
METHOD

Polyelectrolyte microcapsules were made by layer-by-layer (caps-ClE6): $CaCO_3$/PAH: ClE6/ PAH / PSS / (PAH / Fe3O4@CA)2 / PAH / PSS

5.6 pg ClE6 per capsule; average size 3±0.5 μm.



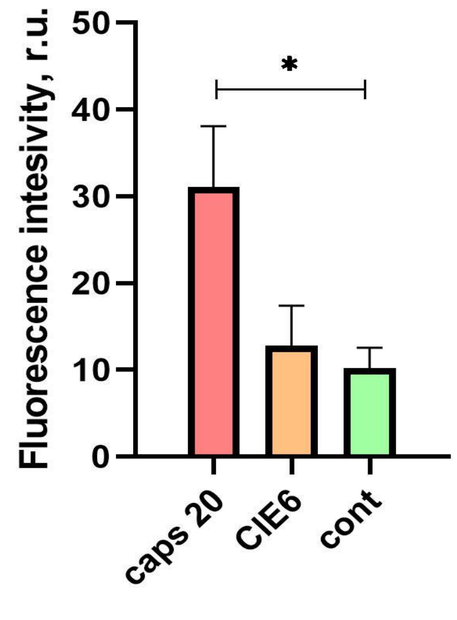
RESULTS & DISCUSSION



MTT-test. For caps-CLE6, the cell viability without RL was more than 70%. In the case of free ClE6, the viability was only 26%. After RL, cell death was 92% and 95% for caps-ClE6 and ClE6, respectively.

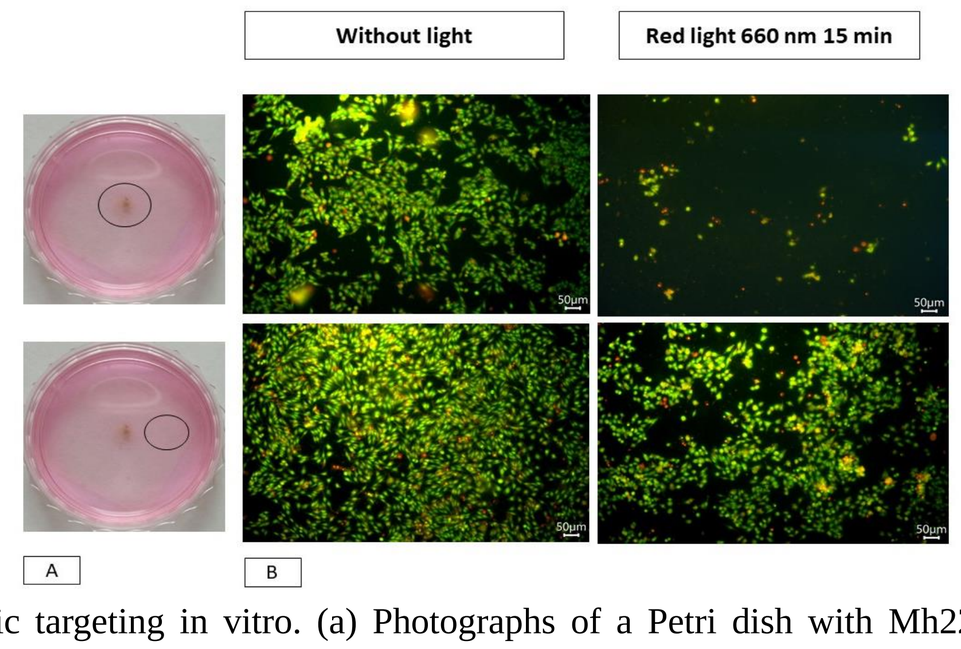
***** $p<0.05$ with control cells

# $p<0.05$ between groups



ROS production in Mh22a cells after RL with ClE6 or caps-ClE6. Untreated cells served as control (cont). ROS generation by caps-ClE6 was 2-fold higher compared to free ClE6.

***** $p<0.05$ with control cells



Magnetic targeting in vitro. (a) Photographs of a Petri dish with Mh22a after exposure to an external magnetic field for 4 hours. Fluorescence images of cells co-stained with AO/EtBr after red RL (660 nm, 15 min) taken at different locations on the Petri dish. Green - live cells, yellow and orange - apoptotic cells, red - dead cells. Scale bar – 50 μm

CONCLUSION

Thus, microcapsules with chlorin E6 had less dark cytotoxicity than free PS in same concentration with the phototoxicity effect via RL. The incubation of the cells with caps-ClE6 on a magnet and irradiation by RL could kill the cells in the area of the magnet without damaging the surrounding cells.

FUTURE WORK / REFERENCES

1. Celli J.P., Spring B.Q., Rizvi I., Evans C.L., Samkoe K.S., Verma S., et al. Imaging and photodynamic therapy: mechanisms, monitoring, and optimization // Chem Rev. - 2010;110:2795e838
2. Dolmans D., Fukumura D., Jain R.K. Photodynamic therapy for cancer // Nat Rev Cancer. – 2003. -3:380e7