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Abstract Book

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Accumulation of Quantum Dots and Chlorin e6 Complex in Distinct Phenotypes of Human Colon Cancer Cells

Emile Peciukaityte[1,2], Evelina Voronovic[1,2,3], Austeja Butkute[1,4], Agata Mlynska[4], Simona Steponkiene[1], Vitalijus Karabanovas[1,2], Ricardas Rotomskis[1,5]

[1]Biomedical Physics Laboratory of National Cancer Institute, Baublio 3B, LT-08406, Vilnius, Lithuania
[2]Department of Chemistry and Bioengineering, Vilnius Gediminas Technical University, Sauletekio av. 11, LT-10223, Vilnius, Lithuania
[3]Life Science Center, Vilnius University, Sauletekio av. 7, LT-10257, Vilnius, Lithuania
[4]Laboratory of Immunology, National Cancer Institute, Baublio 3B, LT-08406, Vilnius, Lithuania
[5]Biophotonics Group of Laser Research Centre, Vilnius University, Sauletekio 9, c.3, LT-10222, Vilnius, Lithuania
emile.peciukaityte@stud.vilniustech.lt

Every year, millions of individuals throughout the world are affected by cancer. There are numerous potential treatments for cancer, but the development of more rapid, novel and precise technologies is still needed [1]. Biomedicine-focused research created the idea of integrating therapy and diagnostics, so-called theranostics, in the search for better ways to treat a variety of human illnesses. The area of nanoscience has existed longer than theranostics itself, but the development of nanoparticles with customizable physicochemical properties and subcellular size has made it possible to create multifunctional theranostic nanoplatforms [2]. For instance, quantum dots (QDs), semiconductor nanoparticles with exceptional optical properties, ultrasmall size, and a high surface area to volume ratio, are used for diagnostics, but if QDs are merged with a photosensitizer, it is possible to create an ideal multifunctional complex for theranostics. Chlorin e6 (Ce6) is a second-generation photosensitizer with a high extinction coefficient, which absorbs a wide range of visible light, including absorption at the red side of the spectrum. As is well known, QDs are combined with chlorin e6 (Ce6) and form a complex that is ideal for biomedical applications [3].

Colorectal tumors are among the most heterogeneous cancer types. Consensus classification of molecular subtypes (CMS) in colorectal tumors distinguishes four categories: immune-mediated CMS1, canonical CMS2, metabolic CMS3 and mesenchymal CMS4 tumors [4]. This classification relies on differential gene expression within colorectal tumors and is partially related to pathological and clinical factors. However, to effectively advance tailored management of different disease subtypes, more evidence provided by the fundamental in vitro research of suitable biological models is needed.

This study aimed to investigate the accumulation of QDs-Ce6 complex in different phenotypes of human colon cancer cells. Firstly, it was determined whether the complex (QDs-Ce6) is stable in several media: distilled water and cell growth RPMI medium without phenol red. Moreover, the flow cytometry and laser scanning confocal microscopy revealed the uptake and distribution of the complex within cancer cells. In parallel, cells were screened for the surface expression of selected stemness and immune markers using flow cytometry. The connection between the accumulation of QD-Ce6 complex and the expression of stemness markers had been investigated.

The complex was indicated as stable in distilled water, therefore the experiments were held with the cell culture growth medium. Each of the growth medium components was examined separately to find the best optimal conditions for the stabilization of the QD-Ce6 non-covalent complex. Once the optimal conditions were set, cancer cell lines, representing different CMS subtypes, were chosen as a model system for studying the accumulation of the QDs-Ce6 complex. The surface marker staining showed the inter- and intra-subtype heterogeneity within selected cell lines and allowed for classifying them based on aggressiveness and immunogenicity. Distribution studies of the QD-Ce6 complex revealed rapid accumulation and localization in the perinuclear region.

Obtained results lead to a conclusion that the QDs-Ce6 complex is stable in different biological media and accumulates at a high rate in cells of different phenotypes. Although cancer cells were phenotypically distinct, the QD-Ce6 complex accumulated similarly in all examined cells.

In conclusion, the QDs-Ce6 complex has the potential to overcome phenotype-related accumulation obstacles in cancer cells and should be further used in biomedical research, especially in theranostics.

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