Development of biological systems for targeted drug delivery in the field of personalized therapy

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INTRODUCTION
At present, the development of new drug delivery systems is an urgent task. Systemic injection of drug-loaded micro- and nano-sized containers can increase circulation time, induce controlled drug release, and thus improve patient comfort and adherence to treatment. Despite great advances in this area, targeting drug users is often random. The body has an innate immune defense that quickly recognizes and destroys foreign objects. Thus, nanocarriers can be captured by macrophages before these carriers reach the region of interest. In addition, toxicity and limited biodegradability are significant disadvantages for many of these approaches. The developed biological carriers, for example, platelets, can bypass the immune barrier, which makes them attractive objects for creating biological systems for targeted drug delivery in the field of personalized therapy.

AIM
The main purpose of platelets is to prevent blood loss in places of vascular damage. In addition, platelets can interact with circulating tumour cells, forming aggregates around the metastatic cell and promoting their adhesion to the vascular endothelium. In this study, the main goal is to create a "Trojan horse" based on platelets for the treatment of metastatic forms of tumor diseases.

METHODS
The surface of nanosized magnetic particles (FeNP) has been modified with a protein (BSA) labelled with a FITC fluorescent dye. Platelets have been isolated from a whole blood of normal volunteer with permission of the institutional ethical committee and the written consents of the individual were taken prior to testing. Isolated platelets have been incubated with FeNP-BSA(FITC). Platelet internalization by nanoparticles was studied using CLSM and AFM.

RESULTS
Magnetite nanoparticles (FeNP) have been developed as drugs, the surface of which has been modified with a fluorescently labeled protein (BSA (FITC)) for visualization in confocal microscopy. The BSA(FITC) adsorption on nanoparticle surface was determined by measuring the size and ζ potential of the particles.

An effective biocompatible drug delivery system based on blood corpuscles has been developed. Thus the labeled platelets seem to be functional, which is a prerequisite for studies assessing in vivo platelet function. Labelling of platelets with FeNP-BSA (FITC) opens new perspectives for platelet personal treatment in human diseases.

CONCLUSIONS
The obtained confocal images show that platelets are able to capture / adsorb magnetic nanoparticles with a fluorescent label on the surface. Left - CLSM images of platelets labeled by the Nile Red fluorescent dye (red channel) (control); right - CLSM images of platelets labeled by the Nile Red fluorescent dye (red channel) and containing FeNP-BSA(FITC) nanoparticle aggregates (green channel).

AFM microscopy showed that a large part of FeNP-BSA (FITC) is internalized on the outer platelet surface. However, it cannot be ruled out that some particles may also be localized within the alpha granules of platelets. Left – AFM images of platelets without FeNP (control); right – AFM images of platelets containing FeNP-BSA(FITC) nanoparticle aggregates.

REFERENCES
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