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The project aims to investigate the molecular mechanisms of novel cell-based targeted delivery drug system. We have recently discovered the possibility to use immune cells as a delivery tool for protein “transporter” in which we are able to encapsulate almost every compound (drug or “contrast” e.g. radio-isotope for PET imaging). The immune cells used in this project very easily uptake the “transporter” (which is a natural compound that is present in every cell), then they highly specifically migrate to the tumour mass (small % goes to the spleen, the rest disperse in the other organs), where they actively transport to cancer cells the protein “transporter” containing i.g. drug (physiologically cancer cells need this protein much more than immune cells).
This is a completely new approach to cancer therapy and diagnostics. However, the molecular mechanism of “transporter” uptake by immune cells, its transport from immune cell to cancer cell as well as immune cell migration to the tumour mass should be further investigated. This interdisciplinary project will involve, besides PI, scientists from various institutions and various fields: newly hired postdoc and two PhD students in cooperation with biostatistician, tumour biologists, cell biologists, biochemist, chemists skilled in radioactivity and PET imaging, veterinary doctor and immunologists specialized in animal models. We will use many various laboratory methods and therefore this project will create good conditions for career development of early stage researchers in various fields.
This project will have a high impact to improve cancer treatment protocols in the future. Cancer is the second leading cause of death, exceeded only by heart disease. According to the United States Cancer Statistics Incidence and Mortality Web-based Report, in 2015 every minute someone dies of cancer in the United States. Solid tumours constitute the unmet medical need. It is related to characteristics of solid tumour microenvironments that limit drug penetration, thereby exposing the tumour to lower than efficacious concentrations of drugs. This is caused by inadequate vasculature resulting in high hypoxia. In these regions cancer cells may survive and cause recurrence or metastasis. For the same reason of limited drug penetration avascular small tumours are undetectable using classic imaging methods. This project will constitute a solid basis for the development of targeted delivery system to the tumour mass. Treatment using this method will descrease the risk of metastasis and recurrence. Additional use of hypoxia-activated drugs makes this therapy even safer. Moreover this delivery system will allow reduction of the dose of given drug and in the same time will allow to reach higher drug concentration inside the tumour mass. In classic chemotherapy only 5% of the drug reaches the tumour (and only its vascular regions) and the remaining 95% goes to other organs causing side effects.
Our method could be used also for treatment of metastatic tumours. Metastasis is an important problem in oncology causing 90% of tumour-related deaths. Micrometastases seem to be particularly difficult because they are avascular and drugs cannot reach these areas. For the same reason (they cannot be reached by contrasting agents) micrometastases cannot be detected using currently used imaging methods. That is why imaging methods are able to detect only tumours larger than 0.5 cm of diameter. The immune cells used in our system are able to migrate to these avascular regions and therefore they may be used in the treatment and imaging of micrometastases.
Our method may be a ground breaking approach in treatment and diagnosis of solid tumours. However, before this method will be subjected to the clinical studies, the underlying molecular mechanisms should be investigated in details and improved and this is an objective of this project.