Design of nanosized drug delivery materials: Determinant biophysical aspects for patient oriented nanotherapy

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The development of nanosized pharmaceutical materials is nowadays facing several challenges in order to design nano drug delivery systems to be applied in patients. The design of biocompatible backbone, the identification of pathological biomarkers for targeted disease nanotherapy and the investigation of potential interaction of the nanomaterial with patient derived biomolecules are the main aspects in which science is striving. In our research group, we have defined a new strategy in which the main aspects of nano drug delivery design are tackled together. Identification of pathological biomarkers recurrent in cancer has been chosen as a target strategy for our systems. Cathepsin B, a fundamental enzyme for the maintenance of the cellular homeostasis, has an increased expression in ovarian cancer. Using enzyme cleavable nanoparticles, we have developed a targeted nanomedical approach to deliver bioactive compounds to ovarian cancer cells. However, the design of targeted nanotherapy has to be implemented with further studies considering the potential interactions of nanoparticles with patient derived molecules. For examples, proteins present in the blood plasma can significantly change biophysical properties of nanomaterials. For instance, the deposition of proteins on the surface of nanovesicles can lead to nanomaterials with increased diameters and different surface charges, which are differently interacting with the targeted cells. Through our study, we have deepened our knowledge investigating the formation of a biocorona on polymeric nanovesicles and studying the difference in cellular uptake after the protein layer formation. We have shown that the biocorona formation is deeply influencing the cellular uptake of nanovesicles of cancer cells. Therefore, we believe that this is a fundamental biophysical parameter for the development of novel pharmaceutical nanosized materials. The implementation of our investigations with alternative animal model, render our study approach very complete and more patient oriented.

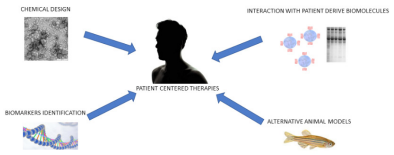

Figure : General representation of innovative strategy to tackle drug delivery design. From the chemical design of biocompatible nanoparticles to identification of novel biomarkers it is possible to design smart responsive nanosized pharmaceutical materials. In addition, implementation of the nanosystems with studies in alternative models and patient derived biomolecules allows the characterization and the fine tuning of biophysical properties for a patient centered nanotherapy

Recent Publications

1. S Sieber, S Siegrist, S Schwartz, F Porta, S Schenk, et al. (2017) Immobilization of enzymes on PLGA sub-micron particles by cross-linked layer-by-layer deposition. Macromol. Biosci., doi:10.1002/mabi.201700015.
2. K Kiene, S H Schenk, F Porta, A Ernst, D Witzigman, et al. (2017) PDMS-b-PMOXA polymersomes for hepatocyte targeting and assessment of toxicity. Eur. J. Pharm. Biopharm. 119:322-332.
3. D Gliesche, J Hussner, D Witzigmann, F Porta, T Glatter, et al. (2016) Secreted matrix metalloproteinase-9 of proliferating smooth muscle cells as a trigger for drug release from stent surface polymers in coronary arteries. Mol. Pharm. 13(7):2290-2300.
4. D Witzigmann, P Detampel, F Porta and J Huwyler (2016) Isolation of multiantennary N-glycans from glycoproteins for hepatocyte specific targeting via the asialoglycoprotein receptor. RCS Adv. Mat. 6:97636-97640.
5. D Witzigmann, S Sieber, F Porta, P Grossen, A Bieri, et al. (2015) Formation of lipid and polymer based gold nanohybrids using a nanoreactor approach. RCS Adv. 5:74320.

Biography

Fabiola Porta graduated in Chemistry from Leiden University, the Netherlands, in 2012 with a thesis focused on the synthesis and characterization of silica mesoporous nanomaterials as drug delivery systems. Since 2013, she has joined University of Basel as a Research Associate in the field of Drug Delivery. At the University of Basel, she is a Lecturer of Bio-Nanomaterials in the Drug Delivery lectures series of the Master of Drug Sciences. In 2017, she has been awarded the "Novartis University of Basel Excellence Scholarships for Life Science". She is now continuing her work on bio-nanomaterials as a Principal Investigator in the group of Biopharmacy of the Department of Pharmaceutical Sciences.

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