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Perfluorodecalin-filled albumin nanocapsules as artificial oxygen carriers

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Despite long lasting efforts, at present a harmless, effective artificial oxygen carrier is missing for clinical use both in Europe and USA. To bypass this, bottleneck albumin-derived perfluorocarbon-based nanocapsules (nanocapsules) were designed as a novel artificial oxygen carrier. Most importantly, nanocapsules do not contain any chemical emulsifier. Nanocapsules are synthesized in different size ranges (\varnothing 100-1500 nm) by using either ultrasonics or a microfluidizer apparatus. Physical assessment of size (DLS, REM/LSM), oxygen transport capacity or the charging of erythrocytes is performed. In different animal models of the rat (topload/normovolemic hemodilution), physiological parameters (e.g. breathing, blood pressure), blood gases, electrolytes and signs of tissue impairment in plasma (e.g. ASAT, LDH) are monitored. Microcirculation of the liver (IVM) and intravascular half-life of nanocapsules and their multiple loading with O₂ are measured (NMR). Successful *in-vitro* experiments concerning the oxygen transport capacity of the nanocapsules (oxygen supply of yeast cells, oxygenation of desoxy-Hb inside erythrocytes) and the proof of bio-functionality in the isolated organ (Langendorff-heart) were followed by *in vivo* experiments (rat) investigating toxicity and pharmacokinetic. Most interestingly, relevant changes in systemic parameters during and after i.v. infusion of nanocapsules were not detected. Microvascular perfusion and oxygen supply by erythrocytes remained unaffected. Parameters indicating tissue impairment did not show any life-threatening deviation. Intravascular half-life of nanocapsules was satisfactory. The subsequent “proof-of-concept” study (rat) to demonstrate the functionality in the complete animal was successful. All animals treated with nanocapsules survived the gradual exchange of about 95% of blood much better than control animals.

Biography

Katja Bettina Ferenz has completed her PhD in Pharmaceutical Chemistry from the “Westfälische-Wilhelms-University Münster” in Germany. Since 2011, she leads her own research group, Development of Artificial Oxygen Carriers at the University of Duisburg-Essen, University Hospital Essen, Institute of Physiological Chemistry, Essen, Germany. She has published 14 papers in reputed journals and participates in the professional training of physicians specialized in transfusion-medicine with lectures on actual developments in the field of artificial oxygen carriers. Her research interests are artificial oxygen carriers, micro- and nanoparticles, nanomedicine, perfluorocarbons, drug delivery and biomaterials.

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