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Biography

Dr. Justin Hanes is the Lewis J. Ort Endowed Professor of Ophthalmology and Director of the Center for Nanomedicine at the Johns Hopkins University, where he also holds faculty appointments in the departments of Biomedical Engineering, Chemical & Biomolecular Engineering, Neurosurgery, Oncology, and Pharmacology & Molecular Sciences. He is an inventor on more than 125 patents and patent applications focused in the area of advanced delivery systems that make drugs safer and more effective. Companies launched based on these patents include Advanced Inhalation Research (acquired by Alkermes), Civitas Therapeutics (acquired by Acorda Therapeutics), Kala Pharmaceuticals (Nasdaq: KALA), and GrayBug Vision. Dr. Hanes is known for developing new methods of targeted and sustained drug and gene delivery to specific sites in the body. He has served on the scientific advisory boards for several companies, including Genentech in the Drug Delivery Division, and he has served as chair of the Gene and Drug Delivery Study Section of the National Institutes of Health. Dr. Hanes is a fellow of the Controlled Release Society, AAPS, and AIMBE, and his awards include being named among “The World’s Top 100 Young Innovators and Leaders in Technology and Business” by the MIT Technology Review, “The World’s Most Influential Scientific Minds” by Thompson Reuters, an Edward C. Nagy Investigator by the National Institute of Biomedical Imaging and Bioengineering of the NIH and a “Global Young Leader” by the US National Academy of Sciences. He was inducted into the National Academy of Inventors in 2014. His degrees are in Chemical Engineering from UCLA (B.S. 1991) and MIT (Ph.D. 1996), and he completed a postdoctoral fellowship in Oncology and Neurosurgery at Johns Hopkins prior to beginning his faculty position in 1998.

Abstract

“Drug and Nucleic Acid Delivery to the Brain”

Nanoparticle-based drug and nucleic acid therapies hold promise to improve treatments for a variety of brain disorders, including brain tumors and neurodegenerative diseases. However, it is difficult to achieve widespread drug and gene delivery in the brain due to the blood brain barrier and the nanoporous and highly adhesive extracellular matrix that minimizes distribution of nanoparticles once they reach the brain parenchyma. We recently demonstrated that sub-114 nm nanoparticles rapidly penetrated healthy brain tissue and brain tumor tissue, but only if they possessed an extremely high surface coverage of hydrophilic and neutrally charged polyethylene glycol (PEG). We used this knowledge to create drug and nucleic acid loaded nanoparticle formulations that more effectively spread within the brain parenchyma following local injection or infusion (“brain penetrating nanoparticles” or “BPN”). We showed that BPN loaded with chemotherapy were more effective in treating rats with brain tumors than similar nanoparticles that do not penetrate as efficiently. Also, unlike DNA nanoparticles with standard PEG coatings, DNA nanoparticles with dense PEG coatings were highly stable in cerebrospinal fluid and rapidly diffused in freshly excised healthy and tumor rodent brain tissues ex vivo. Consistent with ex vivo transport behavior, these “DNA BPN” rapidly penetrated within the brain following administration by convection enhanced delivery, leading to markedly improved distribution and overall level of transgene expression compared to DNA nanoparticles with standard PEG coating densities. With our collaborators, led by Dr. Richard Price at the University of Virginia and Jung Soo Suk at the Johns Hopkins School of Medicine, we found that systemically-administered BPN can be delivered into desired regions of the brain using image-guided focused ultrasound with microbubbles that temporarily disrupt the BBB. We are working with Dr. Price, Dr. Suk and colleagues to test these particles in the treatment of brain cancer, Parkinson’s Disease and other disorders that affect the CNS.