To Fight Drug Addiction, Researchers Target the Brain with Nanoparticles

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(PhysOrg.com) -- A precise, new nanotechnology treatment for drug addiction may be on the horizon as the result of research conducted at the University at Buffalo.

Scientists in UB's Institute for Lasers, Photonics and Biophotonics and UB's Department of Medicine have developed a stable nanoparticle that delivers short RNA molecules in the brain to "silence" or turn off a gene that plays a critical role in many kinds of drug addiction.

The UB team's in vitro findings were published online the week of March 23 in the *Proceedings of the National Academy of Sciences*.

"These findings mean that in the future, we might be able to add a powerful pharmaceutical agent to the current arsenal of weapons in order to more effectively fight a whole range of substance addictions," said Paras N. Prasad, Ph.D., executive director of the UB Institute for Lasers, Photonics and Biophotonics and SUNY Distinguished Professor in the departments of Chemistry, Physics, Electrical Engineering and Medicine, who led the UB team.

The new approach developed by the UB researchers also may be applicable to treating Parkinson's disease, cancer and a range of other neurologic and psychiatric disorders, which require certain drugs to be delivered to the brain.

At the same time, the study's co-authors in the UB Department of

Medicine say this highly translational research strongly suggests that the nanoparticles would be applicable to other diseases. They will soon begin to study their use in treating AIDS dementia, prostate cancer and asthma.

"The findings of this study tell us that these nanoparticles are both a safe and very efficient way of delivering to a variety of tissues highly sophisticated new drugs that turn off abnormal genes," said Stanley A. Schwartz, M.D., Ph.D., professor in the UB departments of Medicine, Pediatrics and Microbiology, director of the Division of Allergy, Immunology and Rheumatology in the UB School of Medicine and Biomedical Sciences, and a co-author on the study.

The PNAS paper describes the development of an innovative way to silence DARPP-32, a brain protein, understood to be a central "trigger" for the cascade of signals that occurs in drug addiction.

DARPP-32 is a protein in the brain that facilitates addictive behaviors. Silencing of the DARPP-32 gene with certain kinds of ribonucleic acid (RNA), called short interfering RNA (siRNA), can inhibit production of this protein and thus, could help prevent drug addiction.

"When you silence this gene, the physical craving for the drug should be reduced," said Adela C. Boniou, Ph.D., a post-doctoral researcher in the Institute for Lasers, Photonics and Biophotonics in the UB Department of Chemistry in the College of Arts and Sciences, and a co-author.

The drawback has been in finding a way to safely and efficiently deliver the siRNA, which is not stable by itself.

The UB researchers were successful when they combined the siRNA molecules with gold nanoparticles shaped like rods, called nanorods.

This may be the first time that siRNA molecules have been used with gold nanorods.

"What is unique here is that we have applied nanotechnology to therapeutic concepts directed at silencing a gene in the brain, using RNA techniques," said Supriya D. Mahajan, Ph.D., research assistant professor in the UB Department of Medicine in the School of Medicine and Biomedical Sciences.

In addition to their biocompatibility, the gold nanorods developed by the UB researchers are advantageous because they are rod-shaped rather than spherical, thus allowing for more siRNA molecules to be loaded on to their surface. This further increases their stability and allows for better penetration into cells.

"We have demonstrated that we can use these gold nanorods to stabilize the siRNA molecules, take them across the blood-brain barrier and silence the gene," said Indrajit Roy, Ph.D., deputy director for biophotonics at the institute. "The nanorods nicely address all three of these requirements."

The nanorods delivered 40 percent of the silencing RNA molecules across the blood-brain barrier model, significantly higher than the amounts that have previously been achieved in other experiments.

In the next stage of the research, the UB scientists will conduct similar experiments in vivo.

The researchers are active participants in the strategic strength in Integrated Nanostructured Systems identified in the UB 2020 planning process, which brings together researchers in the life sciences, medicine and engineering to promote interdisciplinary advancements.

Provided by University at Buffalo (news : web)

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