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Cerebral Palsy: Wayne State University Giving Hope In a Small (Nano) Way

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Scientists in Wayne State's College of Engineering and School of Medicine are creating a novel drug-carrying nanodevice for the treatment of cerebral palsy and other neuroinflammatory diseases.

Cerebral Palsy

by Julie O'Connor

Cerebral palsy, a neurological disorder that appears in infancy or early childhood and permanently affects body movement and muscle coordination, affects 10,000 newborns yearly and 800,000 people overall in the U.S. It occurs as a result of injury to the developing brain that happens before birth or sometimes during the first few months or years of life. Conditions such as prematurity, maternal infections, placental abnormalities and infections such as meningitis or encephalitis that occur in the newborn period may result in brain injury producing cerebral palsy.

A team of researchers from the College of Engineering, School of Medicine and the National Institutes of Health's Perinatal Research Branch have been collaborating to discover and develop new nanodevices that will aid in the diagnosis and treatment of neuroinflammatory diseases and infections that currently are difficult to target and treat.

The team led by Rangaramanujam Kannan, Ph.D., professor of chemical engineering in the College of Engineering, with collaborators Sujatha Kannan, M.D., assistant professor of pediatrics in the School of Medicine and Roberto Romero, M.D., chief of the National Institute of Child Health & Human Development's Perinatology Research Branch (PRB) housed at Wayne State University and the Detroit Medical Center, is developing a therapeutic approach that will target and treat neuroinflammation in cerebral palsy. By developing nanotechnology-based diagnostic and therapeutic approaches for prevention and treatment of maternal infections and fetal brain injury, this

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team's promising approach may one day eliminate or lessen the incidences of cerebral palsy, along with other neuroinflammatory diseases such as age-related macular degeneration, Alzheimer's, multiple sclerosis, amytrophic lateral sclerosis and Parkinson's disease.

These dendrimer-based nanodevices will target and deliver drugs across the blood-brain barrier. According to the research team, their results are the first to show that dendrimers are able to target the specific site of injury in the brain in a neuroinflammation model. Using this nanotherapeutic approach, the targeted drugs are 10 to 100 times more effective than free drugs upon intravenous administration.

"There is an increasing body of literature, in addition to evidence from our own research relating to the disease mechanisms, that suggests that neuroinflammation plays a key role in the pathogenesis and evolution of cerebral palsy and other diseases," said R. Kannan. "We hope to develop therapeutic approaches that will target and treat neuroinflammation resulting in significantly improved treatment outcomes."

A wide variety of neurological diseases are very difficult to treat due to lack of technology able to target the affected regions in the central nervous system. "We believe that our novel drug-carrying nanodevice will offer solutions for treatment of such conditions by delivering drugs to the specific target," R. Kannan added.

Dr. Sujatha Kannan has established an animal model of inflammation that results in a phenotype of cerebral palsy. She, in collaboration with Dr. Diane Chugani, professor of pediatrics and radiology in the School of Medicine, and the Positron Emission Tomography Center, has shown that the presence of neuroinflammation can be detected at a very early stage using noninvasive imaging by Positron Emission Tomography. Clinical translational studies for the detection of neuroinflammation in at-risk newborns are ongoing.

"The PRB has established a unit to develop applications of nanotechnology in perinatal medicine under the leadership of Dr. R. Kannan because we are convinced that this approach will enhance early diagnosis of inflammation *in utero* as well as treatment," commented Dr. Romero. "Dr. Sujatha Kannan and Dr. R. Kannan have explored potential mechanisms to prevent and treat inflammation-induced cerebral palsy. Application to humans requires new methods for diagnosis and drug delivery into the amniotic cavity. Such goals could be accomplished using nanotechnology and, hence, the partnership between Dr. Kannan and the Perinatology Research Branch," Dr. Romero added. The PRB nanotechnology lab now has six postdoctoral researchers and two graduate students with broad research expertise ranging from chemistry, engineering, neuroscience, pharmacology, cell biology, animal model development and imaging.

This novel and high-risk research was initially funded by the Ralph Wilson Medical Research Foundation, which provides money for cutting-edge research in the hope that a breakthrough will be made to find a cure for devastating conditions such as cerebral palsy. Rapid advancements in maternal-fetal medicine have been enabled by the support from the PRB. Through the technology being developed by the Kannan and PRB team, there soon may be a more effective and safe treatment method for treating the fetus/newborn for cerebral palsy and a variety of neurodegenerative conditions that are difficult to treat.

To learn more, visit: http://www.kannangroup.com

About Dr. Rangaramanujam Kannan

Dr. R.M. Kannan received his B.E. in chemical engineering from the Birla Institute of Technology, and a Ph.D. in chemical engineering from the California Institute of Technology. He joined Wayne State University in 1997.

About Dr. Sujatha Kannan:

Dr. Sujatha Kannan received her M.B.B.S degree from the Jawaharlal Nehru Institute of Postgraduate Medical Education and Research (JIPMER, India), and completed her pediatric residency and critical care medicine fellowship at WSU/Children's Hospital of Michigan. She joined WSU/Children's Hospital of Michigan as faculty in 2003.

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