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Fast Track for Stem Cells: Detroit's Hub for Research and Commercialization

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Fast track

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by Amy Oprean

Since the U.S. ban on stem cell research was lifted on March 9, 2009, many pockets of promising research have sprung up across the country as scientists scramble to recharge their efforts in a field that holds tremendous potential.

Through a multitude of funding opportunities and exceptional expertise, Michigan's University Research Corridor – the alliance between Wayne State University, University of Michigan and Michigan State University – has positioned the state to be a major hub for stem cell advancement. Detroit holds particular promise, housing both Wayne State University and Stem Cell Commercialization Center located at TechTown, the university's research and technology park. Together, these entities are creating a gravitational pull for researchers and stem cell-based businesses around the world.

"We've set the stage not only for Detroit to be a place of important breakthroughs, but a place where breakthroughs will see a speedy crossover into the market and into people's lives," said Carol Brenner, associate professor of physiology in WSU's School of Medicine. Brenner is one of Wayne State's head stem cell researchers who is looking forward to advances this hub of innovation will make possible.

"This is the place that I've wanted to see research my entire life," Brenner said. "We are without a doubt still in the basic stages of research, but the possibility of what we can accomplish grows tremendously when there are this many minds in one place."

Having worked in both fertility clinics and academia, Brenner's 25 years of experience

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for Stem Cells
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with stem cells have the rare combination of embryology and basic research. A diverse set of experts is also what brought her to Wayne State, where a multidisciplinary group of mitochondrial, embryonic and basic stem cell biology experts is one of the few of its kind in the country. The group, which is headed by Brenner and James Eliason, Ph.D., associate professor of internal medicine, is working to develop a new method for inducing pluripotency that may produce stem cells that are safe for therapeutics and can be used to model diseases.

Improving technology

Brenner and the team are focusing on adult pluripotent stem cells, specialized cells that have been reprogrammed to take on many of the characteristics of embryonic stem cells. First formed in 2006 from mouse cells and in 2007 from human cells, pluripotent stem cells bypass ethical and legal issues related to embryonic stem cell research. The current industry standard for inducing pluripotency involves using lentiviruses. Although these stem cells can be very useful in modeling diseases, they would cause serious defects if put back into the body.

The group is working on a new method of inducing pluripotency invented by Jianjun Wang, Ph.D., associate professor of biochemistry in WSU's School of Medicine. Gyula Acsadi, M.D., Ph.D., associate professor of pediatrics and Graham Parker, Ph.D., assistant professor of pediatrics in WSU's School of Medicine, have joined Brenner and Wang in developing a method using "protein transduction" instead of viruses to induce pluripotency, with the goal of producing stem cells that can be put back into the body for therapeutics. "Once we successfully develop a method for producing therapeutic stem cells, the door is open for making precursors to specific organs, to making larger quantities of cells needed for therapies and even getting more use out of bone marrow," Brenner said.

With the expertise of Michael Shy, Ph.D., professor of neurology in Wayne State's School of Medicine, the group is also using pluripotent stem cells to model neurodegenerative diseases. Their focus is on the role of mitochondria in the dysfunction of motor neurons, a phenomenon that occurs in nearly every neurodegenerative disease. "We suspect that many neurodegenerative diseases may share many common pathways that are related to the dysfunction of motor neurons," Brenner said. "Previous studies at WSU suggest that mitochondria are somehow involved with this dysfunction."

To start, the team is zeroing in on motor neuron dysfunction in patients with Charcot-Marie Tooth disease, a nerve disorder characterized by loss of muscle tissue, and Spinal Muscular Atrophy, a neuromuscular disease characterized by degeneration of motor neurons. By inducing pluripotency in cells from people with these diseases, they will be able to observe the disease from its very beginning stages through development, allowing them to not only observe the role of mitochondria, but to identify biomarkers and develop a model for the disease.

"Returning the cells back to an embryonic state allows us to go back to the early development and to try to understand the entire process of how the disease manifests," Brenner said. "It's like looking at an embryo with that disease."

Getting a foot up on bringing the research into the next stage, Eliason has also started a company to commercialize the research. Mitostem, at TechTown, was formed to commercialize neural regeneration technology as it's developed.

The commercialization center, which is headed by Eliason as executive director, will be a diverse hub for resources and collaborators that will accelerate advances in stem cell-based therapies while stimulating Detroit's economy through its role as a stem cell-specific business incubator. Some businesses have developed their own technology for things such as bone repair therapy. Many others are biobanks that facilitate faster research by supplying stem cells lines or nutrients required for keeping stem cells alive and healthy.

MitoStem recently received a $200,000 Small Business Innovation Research Phase I grant from the National Institute of General Medical Sciences of the National Institutes of Health to optimize its revolutionary stem cell technology developed at Wayne State University. Issued under the American Recovery and Reinvestment Act of 2009, the grant will allow researchers to develop new stem cell lines relevant for a variety of diseases, and enable the creation of stem cells from patient's own cells for replacement of diseased and damaged tissues.

"Growing stem cells is not a trivial thing; it's tricky," Eliason said. "One of the great things about this center is that it will build up the expertise in

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producing and maintaining good stem cell lines. It will take a lot of the tedious aspects off scientists' hands and give them more time to do interesting research. At the same time, it will allow bio companies to make a name for themselves in this area of growing demand, boosting the economy of Detroit in the process."

With the multidisciplinary group and commercialization center up and running, Brenner sees the coming years being prosperous both in terms of business growth and in crossing the threshold from basic stem cell research to clinical applications that will change people's lives.

"We're really getting all the necessary players in one place to advance basic research and bring it to the next phase as quickly as possible," Brenner said. "It will be incredibly exciting to see where the innovation takes us."

About Dr. Carol Brenner:

Dr. Brenner received a B.Sc. in genetics from Queen Mary College at the University of London, a Ph.D. in molecular embryology from Tufts University in Medford, Mass, and was a post-doctorate in molecular embryology at the University of California, San Francisco. She joined Wayne State in 2007.

Multidisciplinary stem cell team at Wayne State University

Wayne State's unique group of mitochondrial, embryonic and basic stem cell biology experts are working to model neurodegenerative diseases with adult pluripotent stem cells and develop a new method for inducing pluripotency that could finally make stem cells safe for therapeutics. Here is a breakdown of their areas of focus:

Co-principal investigators:

Carol Brenner, Ph.D., associate professor of physiology, School of Medicine
http://www.med.wayne.edu/Embryo/Carol%20Brenner.html

James Eliason Ph.D., associate professor of internal medicine, School of Medicine and executive director of MitoStem http://techtownwsu.org/

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Developing "protein transduction," a potential alternative method of inducing pluripotency in adult stem cells, that does not require lentiviruses.

Jianjun Wang, Ph.D., associate professor of biochemistry, School of Medicine
http://www.med.wayne.edu/biochem/BMB_Faculty/Wang.html

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Testing different culture conditions that could eliminate stress in reprogrammed stem cells.

Randall Armant, Ph.D., professor of obstetrics and gynecology, School of Medicine
http://www.med.wayne.edu/Anatomy/department/armant.htm

Dan Rappolee, Ph.D., associate professor of obstetrics and gynecology, School of Medicine
http://www.med.wayne.edu/anatomy/department/Dan.html

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Creating human stem cell models for neurological diseases.

Gyula Acsadi, M.D.,Ph.D., associate professor of pediatrics, School of Medicine
http://neurology.med.wayne.edu/department/profile.php?id=1838

Graham Parker, Ph.D., assistant professor of pediatrics, School of Medicine
http://www.med.wayne.edu/crcm/laboratories/parker.asp

Michael Shy, Ph.D., professor of neurology, School of Medicine
http://www.genetics.wayne.edu/faculty/shy/index.php

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Studying stem cells in relation to tissue repair and regeneration strategies, and in vitro tissue models.

Howard Matthews, Ph.D., professor of chemical engineering and materials science, College of Engineering
http://www.eng.wayne.edu/che/matthew.htm