Medical Xpress

Stem cells will 'change medicine forever,' says UB surgeon-turned-stem cell engineer

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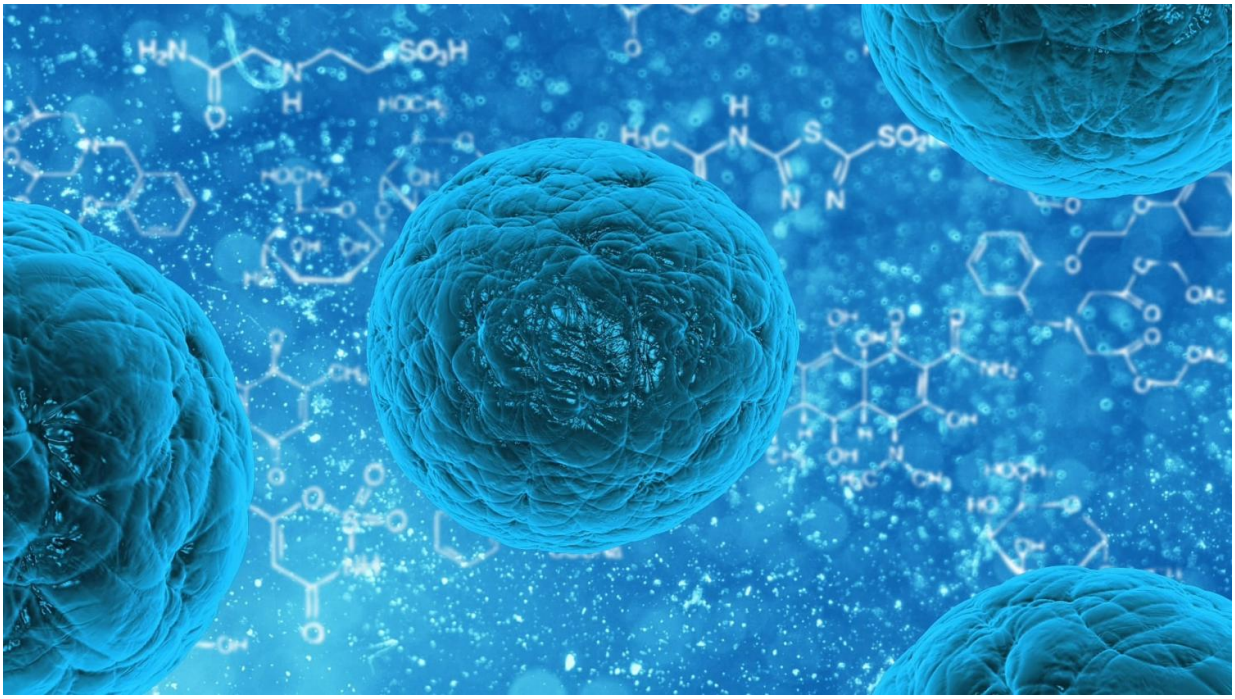

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Natesh Parashurama, MD, Ph.D., assistant professor of chemical and biological engineering at the University at Buffalo, has made his life's mission the translation of stem cell research from the laboratory to patients.

A UB faculty member since 2016, and alumnus of the Jacobs School of

Medicine and Biomedical Sciences, he earned his undergraduate and doctoral degrees from Massachusetts Institute of Technology and Rutgers, and did doctoral research at Harvard Medical School, and postdoctoral research at Stanford University and the University of California, San Francisco.

Parashurama conducts research on building 3-D internal organs, like the liver and pancreas, from human stem cells. Cells from these tissues arise from the endoderm, another focus of his lab. The endoderm is one of the three germ layers in the embryo, ultimately forming some of the body's most important internal organs and tissues. He conducted one of the first studies to isolate endoderm progenitor cells and demonstrated that they can form 3-D tissue in living animals, and coauthored one of the first papers demonstrating how stem cells could reverse liver disease.

As Stem Cell Awareness Day approaches on Oct. 10, Parashurama shared his thoughts on the promise of stem cell science.

You graduated from UB with an MD degree, pursued a residency in surgery at Boston University, and then conducted research on stem cells. Now you are a faculty member in the UB School of Engineering and Applied Sciences working on stem cell technology. Why did you make the career switch?

I gave up my whole surgery career to work on stem cell research. And I was crazy about a surgical career, too, but when I started working on stem cells, I saw great potential in its future and I realized that's what I wanted to do full time.

What is it about stem cells that you find so interesting?

The potential is infinite with stem cells. It's regenerative medicine. Nearly all chronic disease in medicine could be addressed by stem cells. They will change medicine forever. Look at all the different pharmaceuticals patients are prescribed, sometimes for many years, ranging from blood thinners, to drugs to treat chronic pain. However, they are not ideal for treating chronic diseases, because they target a single molecular pathway, whereas curing chronic diseases would require targeting a multitude of pathways.

Your body is composed of cells. If the damaged or injured cells can be replaced with new ones, then you can potentially be cured. Think of the whole cascade of patients with damaged organs and tissues, and being able to rejuvenate or repair them using stem cells. There are now efforts to regrow human organs, eyes and even teeth, which could eliminate the need for dentures. An opportunity like this has never before existed in medicine.

You trained as a surgeon. How do you think surgeries could be impacted by stem cells?

Ultimately, we could replace surgery with organ transplantation by regenerating new organs from stem cells. Right now, patients die on organ transplant waiting lists. In orthopedic surgery, surgeons could use stem cells to build new ligaments in the knee, for example, or to generate new limbs. I'm very sad to say that as a surgeon, I've performed about 100 amputations. Stem cells could change these types of procedures and many others.

What fields in medicine are currently using stem cell technologies in humans?

Stem cells are being used to study and/or treat a number of human

diseases, including treatments for blood disorders, diabetes, Alzheimer's, Parkinson's, heart disease and blindness from macular degeneration. The field took a huge leap recently when, in the United Kingdom, reports surfaced that retinal progenitor cells to treat macular degeneration restore vision in patients.

What kind of stem cell research are you doing at UB?

Here at UB, my lab is using stem cells to build the earliest stages of liver and pancreas tissue, with the ultimate goal of treating liver disease and diabetes. One of my graduate students supported by a Western New York Prosperity Fellowship, is taking the power of stem cell research and building a miniature, but potent weapon to use against liver cirrhosis. Cirrhosis currently can't be treated with stem cells, and it requires liver transplantation, but my student aims to change that.

My second-year graduate student, supported by a New York Stem Cell Science Grant (stem cells in regenerative medicine) graduate fellowship, and a UB Presidential Scholarship, is devising methods to grow thousands of insulin-producing cells using stem cells to treat or even cure Type 1 diabetes. Another graduate student is applying molecular biology, bioinformatics and genomics to understand molecular pathways in stem cell-derived endoderm cells.

How far along is your stem cell research?

There is much work to do, but my graduate student and I have started a company called Livandala to commercialize our research. The technology we are developing uses human pluripotent stem cells—the body's master cells that can differentiate into any type of cell—to eventually regrow liver tissue in patients.

What are the potential benefits of using stem cells to regrow livers?

There is no treatment for people with end-stage liver disease, so a transplant is often the only option. But many patients with cirrhosis never get the transplanted organ, either because they are too high-risk or there are not enough donor organs. There are also major economic benefits for using stem cells. Even when someone is lucky enough to get a transplant, the cost is tremendous and is as high as several hundred thousand dollars or more just for the procedure. Stem cell therapy should be about ten times less costly.

California is well-known as the state with the most advanced stem cell initiative. Why should New York State be investing in stem cell technology as well?

Stem cells are at the interface of all modern biological interfaces. We already can use any cell in your body to generate a human pluripotent stem cell, and that cell can become any cell in your body. Soon we will be able to create truly personalized medicine using these cells. This field rapidly developed in the last 15 years.

The Harvard Stem Cell Institute was established in 2004 with private funds. At the same time, California committed $3 billion to establish the California Institute for Regenerative Medicine (CIRM), an enormous amount for research, education and training. In response, every state university in California, as well as many private institutions, started stem cell institutes or centers and began recruiting top scientists and students. Internationally, stem cell research is very active in Europe, Australia, Canada and Asia.

Fortunately, I was able to participate in this "gold rush." I moved from

Harvard Medical School to Stanford University as a postdoctoral fellow in stem cells and imaging technology, and to the University of California, San Francisco, as a CIRM fellow in human stem cells and human development.

Through NYSTEM, New York State's stem cell initiative, New York needs to continue to push research and education, and develop training programs in the state's schools of medicine and engineering. Throughout the state, we need to establish centers, institutes or departments of regenerative medicine.

Stem cell science is changing many things in medicine and it will teach us what we don't understand about human development. For example, we learn as medical students that once a baby is born, it has all the brain cells and cardiac cells it will ever have, and that there is no regenerative potential in these tissues. These old axioms are now being questioned as a result of stem cell research.

Provided by University at Buffalo

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