JUAN CARLOS IZPISUA BELMONTE

Professor
Gene Expression Laboratory
Roger Guillemin Chair

THE CHALLENGE

Pluripotent stem cells—which can be turned into any cell type in the body—hold promise for treating diseases ranging from cancer to heart disease to blindness. But to develop stem-cell-based therapeutics, researchers first need stem cells. Some researchers harvest pluripotent stem cells from embryos, while others follow a reprogramming protocol developed in 2006 that turns adult cells back to their embryonic state. Both approaches have weaknesses—one requires embryos and the other requires tedious genetic manipulations that might compromise the quality of the generated cells.

THE APPROACH

Juan Carlos Izpisua Belmonte rolls back cells' development to a pluripotent state by improving the methodologies originally described in 2006. In addition, he follows new, more flexible strategies with the goal of providing safer and higher-quality products for regenerative medicine. Izpisua Belmonte has spearheaded the development of new techniques to switch cells from one type—such as skin cells—to another type, from blood to brain to kidney, all the while eliminating the need for pluripotent cells. He has also pioneered methodologies for culturing embryos, including non-human primates, creating synthetic mammalian embryos and organoids. Most notably, he has translated reprogramming technologies to encourage regeneration in living animals in order to, for example, heal heart damage without cell transplantation. All these methods pave the way for stem-cell therapies for a plethora of conditions.

Izpisua Belmonte has also created new ways to alter the genes inside stem cells, potentially allowing researchers to create personalized, "corrected" cells that can be transplanted into a patient to treat inherited disease. He showed the approach works with several diseases, including premature aging syndromes, blood disorders and Parkinson's. The platforms generated by Izpisua Belmonte could be used to correct countless other mutations in stem-cell lines and treat other genetic disorders. Furthermore, he has developed novel stem-cell models of human aging and aging-associated diseases, which may serve as the platform for the discovery of new drivers of aging.

THE INNOVATIONS AND DISCOVERIES

- Izpisua Belmonte has developed new methodologies for the differentiation of human stem cells into various cells types and organoids (such as kidney) as well as methodologies for culturing embryos, including those of non-human primates, and creating synthetic mammalian embryos.
- He has created technologies that allow differentiation of human cells inside embryos of different species. These results, along with his elucidation of the cellular and molecular basis of tissue/organ regeneration, may allow for the generation of human tissues and organs.
- He has generated novel stem-cell models of human aging and aging-associated diseases, leading to the discovery of new drivers of aging.

For more information, please visit:
WWW.SALK.EDU/SCIENTIST/JUAN-CARLOS-IZPISUA-BELMONTE

AGING | DEVELOPMENTAL DISEASE | GENETICS | GENE THERAPY | STEM CELLS THERAPEUTICS | SYNTHETIC EMBRYOS | ORGANOIDS