Seeking superior stem cells: 100-fold increase in efficiency in reprogramming human cells to induced stem cells

October 10 2011

Researchers from the Wellcome Trust Sanger Institute have today announced a new technique to reprogramme human cells, such as skin cells, into stem cells. Their process increases the efficiency of cell reprogramming by one hundred-fold and generates cells of a higher quality at a faster rate.

Until now cells have been reprogrammed using four specific regulatory proteins. By adding two further regulatory factors, Liu and co-workers brought about a dramatic improvement in the efficiency of reprogramming and the robustness of stem cell development. The new streamlined process produces cells that can grow more easily.

"This research is a milestone in human stem cells," explains Wei Wang, first author on the research from the Wellcome Trust Sanger Institute. "Our technique provides a foundation to unlock the full potential of stem cells."

Stem cells are unspecialized cells that are able to renew themselves through cell division and can be induced to become functional tissue- or organ-specific cells. It is hoped that stem cells will be used to replace dying or damaged cells with healthy, functional cells. This could have wide-ranging uses in medicine such as organ replacement, bone replacement and treatment of neurodegenerative diseases.

With more than 20 years of research, gold standard stem cells are derived from mice, largely because they are easy to work with and provide accurate and reproducible results. The team's aim was to develop human cells of equivalent quality to mouse stem cells.

"The reprogrammed cells developed by our team have proved to have the same capabilities as mouse stem cells," states Pentao Liu, senior author from the Sanger Institute. "Our approach will enable researchers to easily engineer and reprogramme human stem cells to generate cell types for cell replacement therapies in humans."

Retinoic acid receptor gamma (RAR-γ) and liver receptor homolog (Lrh-1), the additional regulatory factors used by Liu and co-workers, were introduced into the skin cells along with the four other regulatory proteins. The team's technology produced reprogrammed cells after just four days, compared to the seven days required for the four-protein approach. Key indicators of successfully reprogrammed cells, Oct4 and Rex-1 genes, were seen to be switched on much faster in a much higher number of cells, demonstrating increased efficiency in reprogramming.

"This is the most promising and exciting development in our attempt to develop human stem cells that lend themselves in practical applications. It bears comparison to other technologies as it is simple, robust and reliable," says Allan Bradley, Senior Group Leader and Director of Emeritus at Sanger Institute.

More information: Wang et al. (2011) Rapid and efficient reprogramming of somatic cells to induced pluripotent stem cells by retinoic acid receptor gamma and liver receptor homolog 1 doi: 10.1073/pnas.1100893108

Provided by Wellcome Trust Sanger Institute