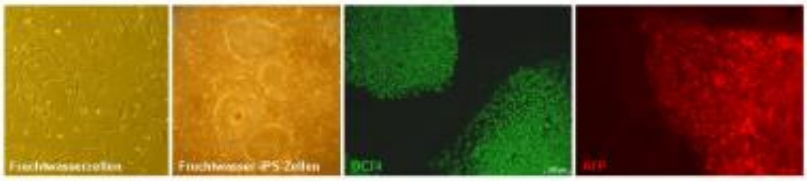
Reprogrammed amniotic fluid cells can generate all types of body cells

November 19 2010



Before their reprogramming into amniotic fluid iPS cells, human amniotic fluid cells are outwardly distinguishable from embryonic stem cells (left). Middle: Amniotic fluid iPS cells produce OCT4 (green), one of the most important marker proteins for embryonic stem cells. Starting from this embryonic stem cell phase, the amniotic fluid iPS cells can form hepatocyte-like cells and others (right). They produce the plasma protein alpha-fetoprotein (red), which is abundant in fetal liver. Image: Max Planck Institute for Molecular Genetics

(PhysOrg.com) -- High hopes rest on stem cells: one day, they may be used to treat many diseases. To date, embryos are the main source of these cells, but this raises ethical problems. Scientists at the Max Planck Institute for Molecular Genetics in Berlin have now managed to convert amniotic fluid cells into pluripotent stem cells. These amniotic fluid-derived iPS cells are hardly distinguishable from embryonic stem cells - however, they "remember" where they came from. (*PLoS One*, October 29, 2010)

The special abilities of embryonic stem cells can today be used in multiple "grown-up" cells (e.g. skin and hair cells). This is done by

reprogramming the cells and converting them to "induced pluripotent stem cells" (iPS cells). These then possess the typical properties of embryonic stem cells, meaning they can generate any of the cell types of the human body (pluripotency), and they can multiply endlessly.

Stem cells with memory

The scientists have shown that the amniotic fluid iPS cells can form different human cell types. They have also discovered that induced pluripotent stem cells can remember the original cell type from which they were generated. During cellular reprogramming, various genes that control the development of stem cells are apparently switched on or remain active. This confirms other current research results, which show that iPS cells derived from distinct tissues are prone to follow their pre-destined developmental path upon spontaneous differentiation. "We don't know just yet whether this donor-cell type memory will have an impact on possible medical treatment, or which type of somatic cell-derived iPS cell will be most suitable for treatment", cautions Katharina Wolfrum of the Max Planck Institute for Molecular Genetics.

Amniotic fluid cells have a number of advantages over other cell types. For one thing, amniotic fluid cells are routinely harvested in antenatal examinations to enable the early detection of disease. In most cases, more cells are obtained than are actually needed. In addition, the amniotic fluid mixture contains different types of cells from the unborn child, including stem-cell-like cells. As they are not very old, they have fewer environmentally-induced mutations, making them genetically more stable. "This may mean that it is possible to reprogram these amniotic fluid cells faster and more easily than other cell types, making amniotic fluid-derived iPS cells an interesting complement to embryonic stem cells", explains James Adjaye of the Max Planck Institute in Berlin.

Moreover, amniotic fluid cells could be extracted for cellular

reprogramming before the birth of a child and be prepared for their intended use while the pregnancy is still ongoing. "This would make it possible to test which drugs work for a baby and whether they are tolerated, before that baby is born. Moreover, in the future, sick newborns can be treated with cells from their own body", says Adjaye.

More information: Katharina Wolfrum, Ying Wang, Alessandro Prigione, Karl Sperling, Hans Lehrach, James Adjaye, The LARGE Principle of Cellular Reprogramming: Lost, Acquired and Retained Gene Expression in Foreskin and Amniotic Fluid-Derived Human iPS Cells, *PLoS One* 2010, 5: e13703. doi:10.1371/journal.pone.0013703

Provided by Max-Planck-Gesellschaft