Editorial

The future of the stem cells: what they are, what they do and what they could be doing?

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Editorial

The potential of stem cell research is almost biblical in its scale and is expanding its potential by limbs and bounds daily. The capacity for these cells to transform into whatever cells or tissues the body may need to regenerate itself could, in the lifetime of the next generation, make the blind see, the spinal cord injured walk, the diabetics healthy and the infertile able to procreate. It could cure cystic fibrosis and arrest muscular dystrophy. Yet it also raises one of the most difficult dilemmas in medical research: ensuring that something which could offer huge rewards to the world's health is not overlooked because it does not offer huge rewards to the national economy and its political leadership. But in spite of those shortcomings, the future lies ahead with those potent cells the body is fortunate to have access to. I recall when I appeared before the Congress of the United States in March of 2001, I reminded this dysfunctional political entity that a cell has been discovered, namely the stem cell which when used and harnessed properly it can change the way we may approach therapeutic medicine as we know it for the future. Scientist first managed to culture embryonic stem cells in 1998 and the fight for stem cells began at that time. However, the fight led us into a somewhat confused direction which also prompted President Bush to ban all research on human embryological stem cell which also managed to put the United States way back in the race for all the advancements that should be forthcoming. It took the US several years to recover from all the advancements in this exciting field and today the USA is still lacking behind other leading countries in the World because of bad decisions made by naïve and ill driven politicians and other entities at the early stages of this very important scientific breakthrough. It is vital that in the light of the dazzling potential of human embryonic stem cell research, and the money that could one day be made from it, we also keep a watchful eye for treatments only public finance will back. That is what happens when true leadership by unambitious and unmotivated politicians is nowhere to be found.

The stem cells: what are stem cells?

Stem cells are the body's basic cells from which all other cells with specialized functions are generated. Under the right conditions in the body or a laboratory, stem cells divide to form more cells called daughter cells. These daughter cells either become new stem cells (self-renewal) or become specialized cells (differentiation) with a more specific function, such as blood cells, brain cells, heart muscle or bone. No other cell in the body has the natural ability to generate new cell types as the stem cells do.

Where do stem cells come from?

Scientists have discovered several sources of stem cells in various compartments of the body:

I. The embryonic stem cells. These types stem cells are derived from embryos that are three to five days old. At this stage, an embryo is called a blastocyst and has about 200 cells. The embryonic stem cells are pluripotent, meaning that they can divide into more stem cells or can give rise via further differentiation and become any type of cell in the body. This versatility allows embryonic stem cells to be used to regenerate or repair diseased tissue and organs, although their use in people has been to date limited to eye-related disorders such as macular degeneration (Figure1).

II. Adult stem cells. These stem cells are found in small numbers in most adult tissues, such as bone marrow or fat and even in smaller quantities in important tissues and organs such as the heart or the liver. Compared with embryonic stem cells, adult stem cells have a more limited ability to give rise to various cells of the body. Until recently, researchers thought adult stem cells could create only similar types of cells. For instance, researchers thought that stem cells residing in the bone marrow could give rise only to blood cells. However, emerging evidence suggests that adult stem cells may be able to create unrelated types of cells. For instance, bone marrow stem cells may be able to create bone or heart muscle cells. This research has led to early-stage clinical trials to test usefulness and safety in people. For example, adult stem cells are currently being tested in people with neurological or heart disease.

III. Adult cells altered to have properties of embryonic stem cells (induced pluripotent stem cells). Scientists have successfully transformed regular adult cells into stem cells using genetic reprogramming. By altering the genes in the adult cells, researchers can reprogram the cells to act similarly to embryonic stem cells. This new technique may allow researchers to use these reprogrammed cells instead of embryonic stem cells and prevent immune system rejection of the new stem cells. However, scientists don't yet know if altering adult cells will cause adverse effects in humans. Researchers have been able to take regular connective tissue cells and reprogram them to become functional heart cells. In studies, animals with heart failure that were injected with new heart cells experienced improved heart function and survival time.

IV. Perinatal stem cells. Researchers have discovered stem cells in amniotic fluid in addition to umbilical cord blood stem cells.

These stem cells also have the ability to change into specialized cells. Amniotic fluid fills the sac that surrounds and protects a developing fetus in the uterus during pregnancy. Investigators and clinicians have been able to identify stem cells in samples of amniotic fluid drawn from pregnant women during a procedure called amniocentesis, a test conducted to test for genetic abnormalities of the growing fetus in utero. Recent developments urge further studies of amniotic fluid stem cells will be necessary to understand their potential.

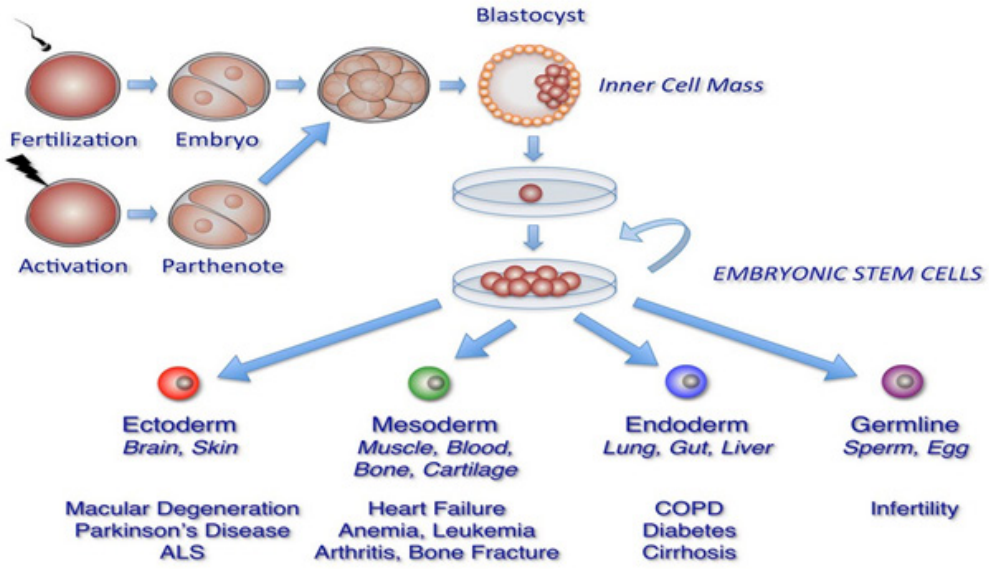

Figure 1 The evolution of embryonic stem cells and their application.

Controversies: why is there a controversy about using embryonic stem cells?

As well established, embryonic stem cells are obtained from early-stage embryos (morulae or blastocysts) which is a group of cells that forms when a woman's egg is fertilized with a man's sperm naturally or during IVF. Because the procedure necessitates that human embryonic stem cells are extracted from human embryos, several questions and issues have been raised about the ethics and morality of any studies performed using such cells obtained via an invasive procedure performed on embryos.

The National Institutes of Health created guidelines for human stem cell research in 2009. Those guidelines are quite restrictive and seek the definition of embryonic stem cells and how they may be used in research and donation guidelines for embryonic stem cells. In addition, guidelines tend to restrict that embryonic stem cells may only be used from embryos created by in vitro fertilization when only when the embryo is no longer needed, and which may be donated voluntarily and with the consent of the intended parents.

Why can't researchers use adult stem cells instead?

Although research into adult stem cells is promising, adult stem cells may not be as versatile and durable as are embryonic stem cells. Adult stem cells may not be able to be manipulated to produce all cell types, which limits how adult stem cells can be used to treat diseases. Adult stem cells also are more likely to contain abnormalities due to environmental hazards, such as toxins, or from errors acquired by the cells during replication. However, researchers have found that adult stem cells are more adaptable than was initially suspected. Stem cells and derived products offer great promise for new medical treatments. More needs to be learned about stem cell types, current and possible uses, ethical issues, and the state of research and practice, today and the future.

It has been very well documented, and one may have heard about stem cells in various publications and perhaps one may have wondered if they might help people with needs and with a serious disease. One may wonder what stem cells are, how they're being used to treat disease and injury, and why they're the subject of such vigorous debate. Here are some answers to frequently asked questions about stem cells.

Why is there such an interest in stem cells?

Researchers and doctors hope stem cell studies can help to:

I. Develop better understanding of how diseases occur**.** By watching stem cells mature into cells in various tissues and organs systemically, researchers and doctors may better understand how diseases and conditions develop.

II. Generate healthy cells to replace diseased cells (regenerative medicine). Stem cells can be guided into becoming specific cells that can be used to regenerate and repair diseased or damaged tissues in people. People who might benefit from stem cell therapies include those with spinal cord injuries, type one diabetes, Parkinson's disease, Alzheimer's disease, heart disease, stroke, burns, cancer, osteoarthritis and even treatment of human male and female infertility. Astonishingly, stem cells may have the potential to be grown to become new tissue for use in transplant and regenerative medicine (in vitro and in vivo). Researchers continue to advance the knowledge on stem cells and their applications in transplant and regenerative medicine.

III. Test new drugs for safety and effectiveness. Before using new drugs in people, some types of stem cells are useful to test the safety and quality of investigational drugs. This type of testing will most likely first have a direct impact on drug development for cardiac toxicity testing.

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New areas of study include the effectiveness of using human stem cells that have been programmed into tissue-specific cells to test new drugs. For testing of new drugs to be accurate, the cells must be programmed to acquire properties of the type of cells to be tested. Techniques to program cells into specific cells continue to be studied. For instance, nerve cells could be generated to test a new drug for a nerve disease. Tests could show whether the new drug had any effect on the cells and whether the cells were harmed.

The future: where do we go from here?

In a field that has such incredible potential, delays are hard to live with and mis directions of such efforts can be devastating. Every year of waiting means that babies with fatal congenital defects can't be treated, diabetics continue to die early, damaged hearts can't be healed. Scientists who have been working for decades to harness the curative powers of stem cells have not forgotten these grand goals. Many are now within touching distance of delivering transformative therapies. Cell therapy trials for age-related macular degeneration and other forms of blindness are delivering promising results; Most recently, scientists came significantly closer to building a pipeline to manufacture vast quantities of Lab-grown blood: a study in monkeys suggested that implanting neurons derived from stem cells could help treat Parkinson's and those exciting break throughs are too numerous to mention. In short, the sky is the limit and let's not jeopardize the future for those that care about it.

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Conflicts of interest

The author declares there is no conflict of interest.

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