Dr. George Johnson ON SCIENCE

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Ethics and science collide: Therapeutic cloning of human stem cells

If mice were human, this spring would have marked amazing advances in the battle against disease. By surgically transplanting cells from early embryos called embryonic stem cells, scientists have performed the remarkable feat of repairing disabled body tissues.

The key to these advances has been a special kind of cell isolated from embryos. After a mouse -- or human -- egg is fertilized, it starts to divide. After a few days, the fertilized cell has become a hollow ball of some 120 cells. Each of these cells, called an embryonic stem cell, is capable of forming all of the many kinds of cells of the adult body.

The basic strategy for repairing damaged tissues is to surgically transfer embryonic stem cells to the damaged area, where the stem cells can form healthy replacement cells. Stem cells transferred into mouse heart muscle develop into heart muscle cells, replacing cells dead from heart attack. Stem cells transferred into a mouse brain form neurons, offering hope they we will eventually learn to use embryonic stem cells to repair spinal injury.

Two weeks ago, scientists at the National Using this procedure, called therapeutic cloning, the researchers succeeded in making cells from the tail of a mouse convert into the dopamine-producing cells of the brain that are lost in Parkinsons disease.

Therapeutic cloning successfully addresses the key problem that must be solved before stem cells can be used to repair human tissues damaged by heart attack, nerve injury, diabetes, or Parkinsons, which is immune acceptance. In theraputic cloning, the body readily accepts stem cells because they are cloned from its own tissues, and so pass the immune system’s “self” identity check.

The mouse experiment carried out by the Rockefeller researchers would have been far more controversial if it had been carried out in humans, because the 120-cell embryo could in principle be brought to term by inserting it into a human uterus.

The thorny ethical issues raised by human therapeutic cloning could be avoided if the stem cells didn’t have to be harvested from an embryo. The holy grail of stem cell research is to find cells able to become any other kind of cell -- technically known as pleuripotent stem cells -- somewhere in the body of an adult human.

Last week researchers reported in the journal Cell that they have found just such cells in the bone marrow of mice. They transplanted single stem cells from mouse bone marrow

Institute of Health employed a complex series of molecular signals to induce embryonic stem cells of mice to become insulin-secreting pancreas cells. The new cells produce only about 2% as much insulin as normal cells do, so there is still plenty to learn, but the take-home message is clear: transplanted embryonic stem cells offer a path to cure type 1 diabetes.

While exciting, these advances in stem cell research were all done in mice. Although human embryonic stem cells were isolated over two years ago, federal research dollars cannot be used to study them because of objections by abortion opponents.

Another reason mouse stem cell research has fluorished is that researchers have developed strains of mice without functioning immune systems. This prevents the mice from rejecting transplanted stem cells as “foreign.” A human with a normal immune system might well refuse to accept transplanted stem cells, simply because they are from another individual.

Only two weeks ago, a research team at the Rockefeller University reported a way around this potentially serious problem. Their solution? They isolate skin cells, then using the same procedure that created Dolly, they create an embryo from them. First they remove the nucleus from the skin cell, and then they insert it into an egg whose nucleus has already been removed. The egg with its skin cell nucleus is allowed to form a 120-cell embryo. The embryo is then destroyed, its cells used as embryonic stem cells for transfer to injured tissue.

into the marrow of individuals whose marrow had been destroyed. After 11 months, the one stem cell had given rise to descendant cells that had migrated throughout the body, forming new bone, blood, lung, esophagus, stomach, intestine, liver, and skin cells. The bone marrow stem cells appear to be the long-sought pleuripotent adult stem cell.

This work too was done in mice. Should we release funds for human studies? The ethical issues are new and troubling -- a decade ago theraputic cloning would have seemed the stuff of science fiction. On balance, I think the enormous potential of stem cells for relieving human suffering far outweighs any harm. Federal funds for human stem cell research should be released immediately.

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