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Bioethics Update

What's Happening in the World of Stem Cells and Cloning?

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Research continues in all areas of stem cells — embryonic and adult. For those of us who do not work in these areas, it can sometimes be difficult to know what is going on. What has been found to be productive in animal experiments? What has been useful in treating people? What are the new areas of discovery? Where is the current scientific focus?

Fundamental to all these questions for people who take the Roman Catholic position seriously, are these considerations: which of the current procedures are morally acceptable, and which are not, within the context of protecting human life at every single stage, from conception until natural death? And which procedures separate the procreative aspect from the unitive?

As a preliminary reminder, it is the fundamental belief in the importance of life at EVERY single stage that seems to be problematic for many people. It can be difficult to convince people that a tiny eight- or ten-day-old embryo is just as important as they are. Size and stage seem to make a difference. Perhaps the fact that we know the embryos in questions are "made" by fusing gametes in a Petri dish already influences people in the direction of thinking: well, humans made these embryos through technology, so why not use a further procedure to experiment on them, especially since they are viewed as "left over"? It is possible that these early human beings are already unconsciously devalued by those who think of them as "products".

Be that as it may, the Roman Catholic Church teaches that ALL life has human dignity from the moment of conception. The way in which a child is conceived is, of course, of vital importance to that teaching. A child should be the fruit of the personal act of intercourse between a man and a woman united in a covenant of marriage. That personal act is theologically explained as inseparably unitive and procreative. Catholic teaching calls *in vitro* fertilization immoral not precisely because it is "unnatural" and brought about by technology, but because it separates the unitive and the procreative dimensions of what should be a personal gift of love between two people, thus destroying the significance of God's gift of procreation.

The human life conceived from that personal act is of irreducible value, from the very beginning of the person's existence. Not every one agrees with that stance, and differing evaluations of human life have led to some extremely permissive policies about what may be done with and to embryos produced through IVF and those which may eventually be produced through cloning. We may ask: what has been happening in research in embryonic stem cells, adult stem cells and cloning during the past year?

Embryonic and Adult Stem Cells

Until the summer of 2007, the main thing to report as far as embryonic stem cell experimentation and research are concerned was actually that the report was much the same as last year's. For that matter, the report has been much the same since research began. Many types of research and experimentation have been undertaken, but to date there have been no real successes in this field. The problems that beset embryonic stem cell experimentation have not been eliminated.

First, in animal experiments, tumours still form as a result of the process, and these purported treatments should clearly be non-transferable to humans. Second, the problem of rejection still occurs. The body recognizes the use of foreign tissue, and reacts by attempting to break it down, and eliminate it. The only way to deal with this problem is for the person to take immunosuppressant drugs for the rest of his/her life, and these drugs are

not without other severe hazards to health.
At the same time as these scientific drawbacks, the central moral question continues to divide scientists, politicians and everyone else who has concerns about this area. Embryonic stem cell experimentation involves withdrawing some stem cells from the embryo, a procedure which results in the death of the embryo. It is, of course, this outcome which means that the Catholic Church (but not only that body) opposes such experimentation. There are other ethical problems concerning the use of embryos, for example the question of consent, but the main concern is over the embryo's death.

These difficulties have been well known to researchers since the beginning of this science, yet a strange phenomenon has occurred, which has continued through recent years. Most scientists continue to talk about embryonic stem cell experimentation in almost hushed tones, as if it promises humankind immense benefits. It is true that seven or eight years ago, those benefits were expected to materialize. Much more money was poured into embryonic stem cell experimentation than into adult stem cell research and experimentation, and it seemed that every scientific journal forecast enormous successes in this area.

It is also true that, at the beginning, it did not appear that research with adult stem cells was going to prove as fruitful. It was thought that adult stem cells would be useful for some specific tasks, but could achieve nothing beyond this.

Embryonic stem cells have properties that render them capable of taking on the particularities of just about any part of the body to which they are directed. For that reason, they are called "totipotent", or at least "pluripotent". Stem cells in embryos do not differentiate until fourteen days; that means they do not become targeted for specific parts of the body — lung, liver, heart — until that point. That is why embryos must be implanted in the womb at fourteen days, before specialization (differentiation) begins. Adult stem cells, because differentiated, were thought to be less useful.

Successes in the Use of Adult Stem Cells

In an interesting development, that assumption has been totally disproved by the scientific results. Some researchers continued to work with adult stem cells despite their perceived lack of potency, but it turned out that adult stem cells have many more capabilities than was expected, and have shown themselves capable of regenerating tissue in parts of the body other than those parts from which they were extracted. Some examples: *First*, researchers have found a way to stimulate growth of neural stem cells in the brains of adult mice, giving rise to a hope that a person's own stem cells will be able to be used to help regenerate parts of his/her damaged brain.[1]

Second, about a year ago, English researchers grew the world's first artificial human liver in a laboratory, using stem cells obtained from umbilical cord blood.[2] These livers are capable of being used to test new drugs and, in future years, of providing life-saving treatment to patients in need of liver transplants. Researchers predict the science, with none of the ethical concerns associated with the use of embryonic stem cells, will be used to repair damaged livers within the next five years, and within 15 years whole artificial livers will be grown to be used in transplants. This is an area where scientists predict success, although telling us that it could take ten or even fifteen years before this type of procedure will be in general use.

Third, a new treatment has been discovered for blocked arteries and is already in use for patients with that dangerous condition.[3] The treatment allows them to grow new, healthy blood vessels to improve circulation, preventing blocked arteries. A growth factor called GMCSF is injected, stimulating bone marrow to release stem cells from that site, and helping the body form new arteries. Preliminary study results showed patients' blood vessel function improved by up to 60 per cent and they were also able to exercise longer without pain. Larger studies are needed before this treatment could become widely used, but improved blood vessel function would mean fewer heart attacks, strokes, and amputations. Doctors say this concept could potentially be applied to blocked arteries carrying blood to both the heart and the brain.

There are literally hundreds of examples of successful uses of adult stem cells, reported in many articles and on many websites. The Deputy Director of Pro-life Activities for the U. S. Conference of Catholic Bishops compiled a summary of these successes under the trenchant heading, *75 New Reasons to reconsider the alleged Need for Stem Cell Research that destroys Human Embryos*.[4] The list includes articles and reports on the use of cord blood to treat childhood leukemia; the use of stem cells from muscles in forming bone through gene-silencing; new treatments for glaucoma; human heart tissue grown from stem cells; injecting a patient's own stem cells to treat severe coronary artery disease, amniotic stem cells and their role in congenital heart defects, etcetera.

It is truly exciting to learn about these developments, which are listed on www.stemcellresearch.org. This is an important "go-to" site for anyone interested in any kind of stem cell research and experimentation.

Stem Cell Reporting in the Media

The point is that clearly there have been many developments in the use of adult stem cells in helping find cures for severe illnesses, congenital and otherwise. But how many of us know about this? It appears that most of our media sources block news of this kind, instead continuing to extol the work being done in embryonic stem cell research.

Wesley Smith, an American journalist and observer of this area, often comments on this phenomenon, and it does seem rather strange that advances are not heralded in the general press as one might expect. Scientific journals carry this information, but are not as accessible to the general public. The Bishops of Michigan recently published a short brochure on stem cell research for their diocese, and the results of embryonic versus adult stem cell research and experimentation are reported in the manner of a football score:

Adult Stem Cells 131 v Embryonic Stem Cells 0

This brings home the point that the use of adult stem cells in finding cures has been much more promising than predicted. Physical hazards to the patient are virtually non-existent, and there are no moral dilemmas of the order of embryo destruction.

Cloning

Dr. Ian Wilmut made history several years ago in cloning the now famous sheep, Dolly. The technology of cloning has developed since then in many areas, resulting in the capacity to clone human embryos. This is forbidden in Canada and most countries, but is allowed, for example, in the UK. A further distinction is made between "reproductive" and "therapeutic" cloning. Therapeutic cloning is permitted, but reproductive cloning is not. "Therapeutic" cloning means that embryos are produced in order to harvest their stem cells. "Therapeutic" in fact does not relate to the embryos themselves (which are destroyed in the process), but rather to someone else's therapy. It is a misnomer, as in "therapeutic abortion", but serves to make society think that what is going on has some altruistic, even noble, qualities.

"Reproductive" cloning is illegal in the UK: cloned embryos may not be brought to term, although it is impossible to know whether this has ever been attempted. Most scientists warn that the technique is not nearly advanced enough to be used, since there have been ongoing problems in animal cloning, although there have been two recent successes.

First, in Japan, in June 2007, it was reported that healthy mice had been cloned from skin stem cells, by removing the nucleus from an unfertilized mouse egg cell and replacing it with the nucleus from an adult skin cell.[5] These were then cultured in the laboratory to become early embryos, or blastocysts, before being implanted in the womb of adult mice and brought to term.

Second, in November 2007, Oregon Health and Science University announced that it had cloned primate embryos, and had developed embryonic stem cell lines from them.[6] Skin cells from a nine-year-old rhesus macaque were united with unfertilized monkey eggs with the DNA removed. These successes were the first since "Dolly" to have potential for developing treatments for humans. The media response was jubilant –in clear contrast to the lack of fanfare that has greeted successful treatment of humans with adult stem cells.

A new development in stem cell research

Despite these successes, Ian Wilmut recently announced that he is abandoning cloning, and is investigating a Japanese method of creating stem cells which uses a different method from nuclear transfer, or cloning. This method would appear to completely bypass the need for cloning, or for using embryos at all. This means that the current ethical issues involved in embryonic stem cell research would be resolved, and we can look forward to treatments which will be ethically acceptable to all.

What has changed? In 2006, researchers at Kyoto University found a way to create human embryonic stem cells without using human eggs, and without the need to create and destroy human cloned embryos.[7] They were able to turn skin cells into stem cells, inducing adult, differentiated cells to revert to the embryonic, pluripotent state. The implications of this are that human skin cells could be similarly manipulated, for example to form muscle cells to repair the heart, or brain cells to be used a treatment for Parkinson's. These cells would not be rejected by the body, since the patient's own skin cells would be used.

A major moral question that must be asked is whether these cells, once reverted to embryonic pluripotent form, differ in any way from those extracted from embryos, each cell of which has the capacity to become a separate

organism. Takahashi and Yamanaki reported that they had developed cell lines with *some* of the pluripotent properties of embryonic stem cells (ES cells), calling them "induced pluripotent stem cells" (iPS).[8] It is not clear, however, whether the answer to this question is completely known yet.

Chimeras, Hybrids, and Cybrids

The British Human Fertilization and Embryology Authority (HEFA) now allows the use of animal eggs, especially cow eggs, to create cloned human embryos. This was partly in response to the difficulty in obtaining human eggs, as a way of ensuring a ready supply for experimentation. The aim is to make embryos to be used at the sixth day of development for the extraction of embryonic stem cells. These embryos are not true chimeras, nor hybrids, since they are not a mixture of cells from two different species. The only genetic material left from the animal is the DNA of the mitochondria, and the name "cybrid" has been suggested, since only the cytoplasm of the animal egg merges with the nucleus of the human cell used in the process.

This procedure has been met with some enthusiasm by some researchers, with the proviso that no such embryo may be implanted. It is not allowed in Canada, nor in most other countries, where grave moral reservations about mixing species still exist.

In any event, this procedure, too, is likely to be abandoned if the use of induced pluripotent stem cells proves to be as successful as is claimed. If the new procedure meets the necessary criterion of non-destruction of human embryos, then, as in the important successes in the use of adult stem cells, we can rejoice that our Catholic values are being respected in the treatments and cures for human illness and disease that we pray will ensue.

[1] "Scientists spur growth of adult brain stem cells." MSNBC Health. 14 Nov 2006. MSNBC. 21 Nov 2007 <http://www.msnbc.msn.com/id/15720021/from/ET/>.

[2] Christensen, Bill. "World's First Artifical Liver Grown In Labs." *Live Science*. 31 Oct 2006. 21 Nov 2007 <http://www.livescience.com/health/061031_artif_liver.html>.

[3] "Using The Body's Own Stem Cells To Grow New Arteries." *ABC7 News.* 12 Nov 2006. ABC. 21 Nov 2007 <http://abclocal.go.com/kgo/story?section=edell&id=4754901>.

[4] "75 New Reasons To Reconsider The Alleged Need For Stem Cell Research That Destroys Human Embryos ." *DoNo-Harm: The Coalition of Americans for Research Ethics.* 21 Nov 2007 <http://www.stemcellresearch.org/alternatives/75newreasons.pdf>.

[5] "Mice Cloned From Skin Stem Cells." *BBC news*. 13Feb 2007. BBC News. 21 Nov 2007 <http://news.bbc.co.uk/2/hi/health/6353919.stm>.

[6] Pincock , Stephen. "Stem Cells from Cloned Primates." *News in Science*. 19 June 2007. ABC Science Online. 21 Nov 2007 <http://www.abc.net.au/science/news/stories/2007/1955638.htm>.

[7] Rossant , Janet. "Stem cells: The Magic Brew." *Nature.com*. 13Feb 2007. *Nature Magazine*. 21 Nov 2007 <http://www.nature.com/nature/journal/v448/n7151/full/448260a.html>.

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