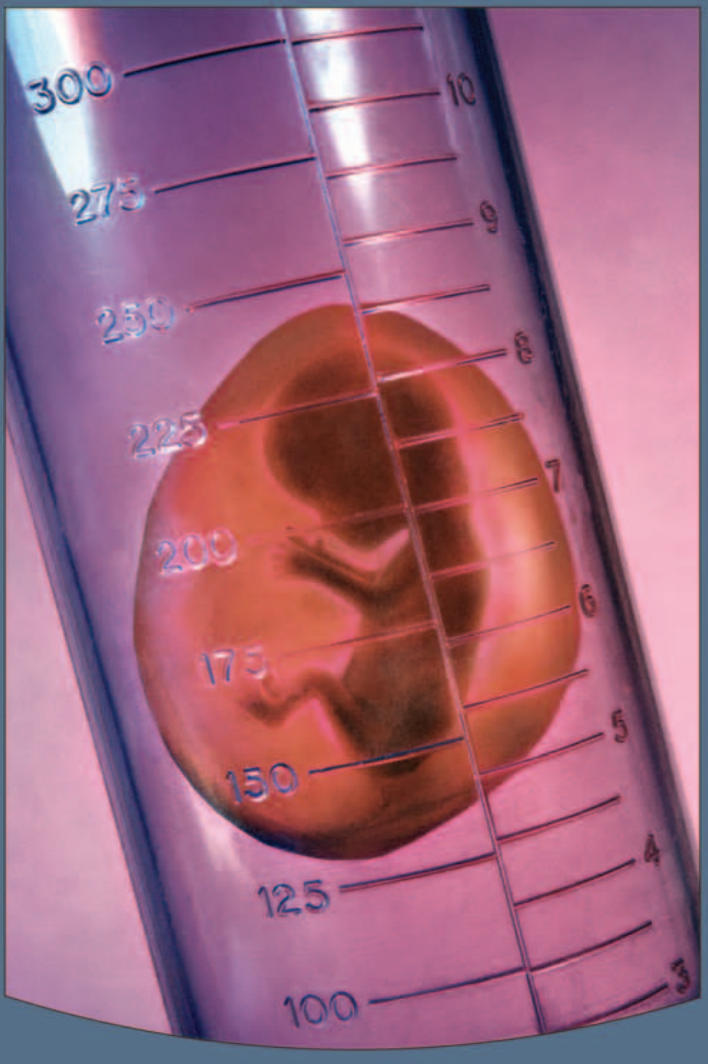

Stem Cell Research, Cloning & Human Embryos

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BY REV. DR. TADEUSZ PACHOLCZYK

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Stem Cells

What is a Stem Cell?

A stem cell is essentially a "blank" cell, capable of becoming another more differentiated cell type in the body, such as a skin cell, a muscle cell, or a nerve cell.

Why are Stem Cells Important?

Stem cells can be used to replace or heal damaged tissues and cells in the body.

What are the Two Broad Classes of Stem Cells?

The two basic types of stem cells are embryonic type and adult type.

- Embryonic Stem Cells
- Embryonic Germ Cells

"embryonic type"

- Umbilical Cord Stem Cells
- Placental Stem Cells
- Adult Stem Cells

"adult type"

Where do Embryonic Type Stem Cells Come From?

- EMBRYOS—Embryonic stem cells are obtained by harvesting living embryos which are generally 5-7 days old. The removal of embryonic stem cells invariably results in the destruction of the embryo.

- FETUSES—Another kind of stem cell, called an embryonic germ cell, can be obtained from either miscarriages or aborted fetuses.

Where do Adult Type Stem Cells Come From?

- UMBILICAL CORDS, PLACENTAS AND AMNIOTIC FLUID—Adult type stem cells can be derived from various pregnancy-related tissues.
- ADULT TISSUES—In adults, stem cells are present within various tissues and organ systems. These include the bone marrow, liver, epidermis, retina, skeletal muscle, intestine, brain, dental pulp, and elsewhere. Even fat obtained from liposuction has been shown to contain significant numbers of adult type stem cells.
- CADAVERS—Neural stem cells have been removed from specific areas in post-mortem human brains as late as 20 hours following death.

How Do Embryonic and Adult Stem Cells Compare?

EMBRYONIC STEM CELL ADVANTAGES

1 Flexible—appear to have the potential to make any cell

2 Immortal—one embryonic stem cell line can potentially provide an endless supply of cells with defined characteristics

3 Availability—embryos from in vitro fertilization clinics

EMBRYONIC STEM CELL DISADVANTAGES

1 Difficult to differentiate uniformly and homogeneously into a target tissue

2 Immunogenic—embryonic stem cells from a random embryo donor are likely to be rejected after transplantation

3 Tumorigenic—Capable of forming tumors or promoting tumor formation

4 Destruction of developing human life

ADULT STEM CELL ADVANTAGES

1 Special adult type stem cells from bone marrow and from umbilical cords have been isolated recently which appear to be as flexible as the embryonic type

2 Already somewhat specialized—inducement may be simpler

3 Not immunogenic—recipients who receive the products of their own stem cells will not experience immune rejection

4 Relative ease of procurement—some adult stem cells are easy to harvest (skin muscle, marrow, fat), while others may be more diffi cult to obtain (brain stem cells). Umbilical and placental stem cells are likely to be readily available

5 Non-tumorigenic—tend not to form tumors

6 No harm done to the donor

ADULT STEM CELL DISADVANTAGES

1 Limited quantity—can sometimes be difficult to obtain in large numbers

2 Finite—may not live as long as embryonic stem cells in culture

3 Less flexible (with the exception of #1 above)—may be more difficult to reprogram to form other tissue types

Treatments from Adult Stem Cells

LEUKEMIA

Patrizia Durante was diagnosed with acute leukemia six months into her pregnancy. Her daughter, Victoria Angel, was born healthy, but Durante was given only six months to live. The stem cells from the blood of her daughter's umbilical cord were used for a transplant. Several years later, Durante is in full remission. "She saved her mommy," Durante told reporters. "She's a little miracle. That's why we named her Victoria Angel. She's my little angel."

KRABBE'S LEUKODYSTROPHY

Gina Rugari was born with Krabbe's leukodystrophy. This is a rare, degenerative enzyme disorder of the nervous system, in which the baby shows initial signs of irritability and developmental delay or regression. Seizures and fevers often follow, then blindness and deafness until the baby dies, usually before age 2. Gina was tested for Krabbe's leukodystrophy shortly after she was born, because she had a brother who had died from the disease. Doctors treated Gina with chemotherapy to destroy her immune system, and introduced new umbilical cord blood stem cells from a closely matched donor. The transplanted cells produced the missing enzyme. Her body accepted the cells, and she is thriving several years after the transplant.

Why are Adult Stem Cells Preferable to Embryonic Stem Cells?

Adult stem cells are a "natural" solution. They naturally exist in our bodies, and they provide a natural repair mechanism for many tissues of our bodies. They belong in the microenvironment of an adult body, while embryonic stem cells belong in the microenvironment of the early embryo, not in an adult body, where they tend to cause tumors and immune system reactions.

Most importantly, adult stem cells have already been successfully used in human therapies for many years. As of the date of this publication, NO therapies in humans have ever been successfully carried out using embryonic stem cells. New therapies using adult type stem cells, on the other hand, are being developed all the time. There are many examples of success stories using adult stem cells.

Is Stem Cell Research Ethical?

Most types of stem cell research are morally acceptable and laudable. Only research using embryonic stem cells raises insuperable moral objections. An ethical overview:

- EMBRYONIC STEM CELLS—always morally objectionable, because the human embryo must be destroyed in order to harvest its stem cells
- EMBRYONIC GERM CELLS—morally objectionable when utilizing fetal tissue derived from elective abortions, but morally acceptable when utilizing material from spontaneous abortions (miscarriages) if the

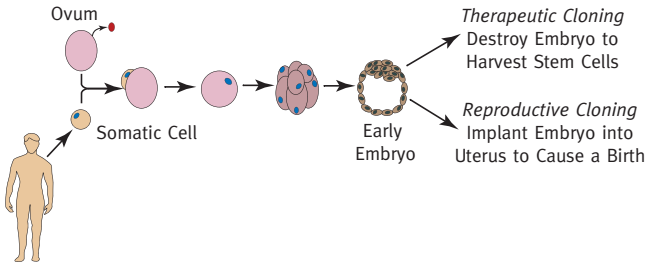
parents give informed consent

- UMBILICAL CORD STEM CELLS—morally acceptable, since the umbilical cord is no longer required once the delivery has been completed
- PLACENTALLY-DERIVED STEM CELLS—morally acceptable, since the afterbirth is no longer required after the delivery has been completed
- ADULT STEM CELLS—morally acceptable, assuming informed consent from the adult donor

Cloning

What are the Two Types of Cloning?

The first and most well known type of cloning is cloning to produce children, or "reproductive cloning." The second type of cloning is cloning for biomedical research, or "therapeutic cloning."



What is Reproductive Cloning (Cloning to Produce Children)?

Humans may one day be able to be cloned using a procedure similar to the one used to generate Dolly the sheep. This kind of cloning involves taking the nucleus of a body (somatic) cell and introducing it into an egg cell (ovum) which has had its nucleus removed. The resultant cloned embryo is then implanted into a uterus to bring it to birth. The cloned embryo is an identical twin of the person who donated the starting somatic cell. Cloning is simply another approach to mimicking the biology that generates identical twins.

What is Theraputic Cloning (Cloning for Research)?

Therapeutic cloning involves making a cloned embryo by the same series of steps as reproductive cloning, but instead of implanting it into a uterus to be born, the embryo is destroyed to harvest its stem cells. Hence, therapeutic cloning is identical to reproductive cloning except for the final step. Therapeutic cloning is sometimes referred to as the "clone and kill" technique. The aim is to obtain rejection-proof stem cells for transplantation into the person from whom the clone was made. Because stem cells from the clone are actually from the identical twin of the person cloned, they should theoretically be a good match and not be rejected.

Why is Human Reproductive Cloning Wrong?

Cloning participates in the basic evil of moving human procreation out of the setting of committed marital intimacy and into the laboratory. Human procreation

should not take place in the laboratory because it is inherently dehumanizing to bring a new human being into the world through means which replace the marital act. Each of us has a right to be brought into the world as the fruit and expression of marital love, rather than as the product of technical domination and manufacturing protocols. Procreation is not meant to be replaced by production. There is a dignity both to the process of procreation as established by God through sexual self-giving, and the dignity of the life itself which is engendered by that process. Cloning threatens human dignity on both of those levels.

Cloning also represents a sort of genetic engineering. Instead of choosing just a few of the features you'd like your offspring to have, like greater height or greater intelligence, cloning could allow you to choose all of the features, so it represents an extremely serious form of domination and manipulation by parents over their own children. It represents a type of parental power that parents are not intended to have. Ultimately, cloning is a type of human breeding, a despotic attempt by some individuals to dominate and pre-determine the make-up of others. With cloning you also distort the relationships between individuals and generations. If a woman were to clone herself, using her own egg, her own somatic cell, and her own womb, she wouldn't need to have a man involved at all.

Oddly, she would end up giving birth to her own identical twin—a twin sister who would also be her daughter.

Why is Human Theraputic Cloning Wrong?

If human reproductive cloning—the bringing to birth of a new child who is an identical twin to somebody else—is wrong, then therapeutic cloning is worse.

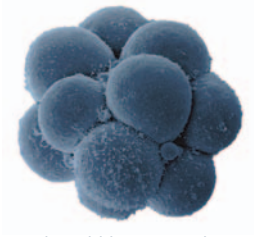
Therapeutic cloning is the creation of that same identical twin for the premeditated purpose of ending her life in order to harvest her tissues. In sum, there is a grave evil involved in therapeutic cloning because life is created for the explicit purpose of destroying it. With a cloned birth, at least we would end up with a baby that is alive. Human therapeutic cloning, the artificial creation of a human life for the sole purpose of her exploitation and destruction, will always be gravely unethical even if the desired end is a very good one, namely the curing of diseases. Therapeutic cloning sanctions the direct and explicit exploitation of one human being by another, in this case, the exploitation of the weak by the powerful.

The danger of therapeutic cloning lies in the intentional creation of a subclass of human beings, made up of those still in their embryonic or fetal stages, who can be freely exploited and discriminated against by those fortunate enough to have already passed beyond those early embryonic stages.

Therapeutic cloning raises further serious slippery-slope concerns. The temptation to make embryos that can be exploited for their stem cells offers the further temptation to grow those cloned embryos within a uterus to the point of a fetus. Such a fetus can then be aborted and conveniently harvested for needed organs, avoiding the trouble of having to start from scratch with undifferentiated stem cells.

Human Embryos

Where do Human Embryos Come From?



4-day-old human embryo at the 16-cell stage

- From the combining of sperm and egg (fertilization)
- From embryo splitting (fission)
- From somatic cell nuclear transfer (cloning)

Are Embryos Human? Are They Really One of Us?

Embryos are no different in their essential humanity from a fetus in the womb, a 10-year old boy, or a 100-year old woman. At every stage of development, human beings (whether zygote, blastocyst, embryo, fetus, infant, adolescent, or adult) retain their identity as an enduring being that grows towards its subsequent stage(s); embryos are integral beings structured for maturation along their proper time line. Despite their unfamiliar appearance, embryos are what very young humans are supposed to look like.

Isn't it a Matter of Religous Belief as to When Human Beings Begin?

It is not a matter of religious belief, but a matter of biology. A human embryo is a human being, a being that is clearly and unmistakably human. It is not a zebra-type

of being, a plant-type of being or some other kind of being. Each of us was once an embryo, and this affirmation does not depend on religion, belief systems, or imposing anything on anyone. It depends only on a grasp of basic biology. It is a matter of empirical observation. Once you are constituted a human being (which always occurs at fertilization or at an event that mimics fertilization, like cloning), you are a new member of the human race who must be protected unconditionally. The human embryo is a being that is human, and such beings are inviolable entities, because that's what we all directly spring from at the root level.

Why is the Destruction of Human Embryos Wrong?

The well-known moral principle that good ends do not justify immoral means applies directly here. Once you're a being who is human, you are the bearer of human rights and you should never be violated for any reason. We know that the human embryo is a human being because it possesses an internal code for self-actualization and is an organism with an independent and inherent teleology (goal-directedness) to develop into an adult, and is physiologically alive and genetically human. Our existence as human beings is a continuum that extends all the way back to our origins in that humble ball of cells we call an embryo. Each of us has our origins in such an embryo, and therefore human embryos should never be depersonalized or instrumentalized for research purposes by strip-mining them for their cells or tissues.

The 10 Great Media Myths
in the Debate Over Stem Cell Research

Myth 1. STEM CELLS CAN ONLY COME FROM EMBRYOS. In fact, stem cells can be taken from umbilical cords, the placenta, amniotic fluid, adult tissues and organs such as bone marrow, fat from liposuction, regions of the nose, and even from cadavers up to 20 hours after death.

Myth 2. CHRISTIANS ARE AGAINST STEM CELL RESEARCH. There are four categories of stem cells: embryonic stem cells, embryonic germ cells, umbilical cord stem cells, and adult stem cells. Given that germ cells can come from miscarriages that involve no deliberate interruption of pregnancy, Christians in general oppose the use of only one of these four categories, i.e., embryonic stem cells. In other words, most Christians approve of three of the four possible types of stem cell research.

Myth 3. EMBRYONIC STEM CELL RESEARCH HAS THE GREATEST PROMISE. Up to now, no human being has ever been cured of a disease using embryonic stem cells. Adult stem cells, on the other hand, have already cured thousands. For example, bone marrow cells from the hipbone have repaired scar tissue on the heart after heart attacks. Research using adult cells is 20-30 years ahead of embryonic stem cell research and holds greater promise. This is in part because stem cells are part of the natural repair mechanisms of an adult body, while embryonic stem cells do not belong in an adult body (where they are likely to form tumors, and to be rejected as foreign tissue by the recipient). Rather, embryonic stem cells really belong only within in the specialized microenvironment of a rapidly growing embryo, which is a radically different setting than an adult body.

Myth 4. **EMBRYONIC STEM CELL RESEARCH IS AGAINST THE LAW.** In reality, there is no law or regulation against destroying human embryos for research purposes. While President Bush has banned the use of federal funding to support research on embryonic stem cell lines created after August 2001, it is not illegal. Anyone using private funds is free to pursue it.

Myth 5. **PRESIDENT BUSH CREATED NEW RESTRICTIONS TO FEDERAL FUNDING OF EMBRYONIC STEM CELL RESEARCH.** The 1996 Dickey Amendment prohibited the use of federal funds for research that would involve the destruction of human embryos. Bush's decision to permit research on embryonic stem cell lines created before a certain date thus relaxes this restriction from the Clinton era.

Myth 6. **THERAPUTIC CLONING AND REPRODUCTIVE CLONING ARE FUNDAMENTALLY DIFFERENT FROM EACH OTHER.** The creation of cloned embryos, either to make a baby or to harvest cells, occurs by the same series of technical steps. The only difference is what will be done with the cloned human embryo that is produced. Will it be given the protection of a woman's womb in order to be born? Or will it be destroyed for its stem cells?

Myth 7. **SOMATIC NUCLEAR CELL TRANSFER IS DIFFERENT FROM CLONING.** In fact, "somatic cell nuclear transfer" is simply cloning by a different name. The end result is still a cloned embryo.

Myth 8. **BY DOING SOMATIC CELL NUCLEAR TRANSFER, WE CAN DIRECTLY PRODUCE TISSUES OR ORGANS WITHOUT HAVING TO CLONE AN EMBRYO.** At the present stage of research, scientists are unable to bypass the creation of an embryo in the production of

tissues or organs. In the future it may be possible to inject elements from the cytoplasm of a woman's ovum into a somatic cell to "reprogram" it into a stem cell. This is called "de-differentiation." If so, there would be no fundamental moral objection to this approach to getting stem cells.

Myth 9. EVERY BODY CELL, OR SOMATIC CELL, IS SOMEHOW AN EMBRYO AND THUS A HUMAN LIFE. People sometimes argue: "Every cell in the body has the potential to become an embryo. Does that mean that every time we wash our hands and are shedding thousands of cells, we are killing life?" The problem is that this overlooks the basic biological difference between a regular body cell, and one whose nuclear material has been fused with an unfertilized egg cell, resulting in an embryo. A normal skin cell will only give rise to more skin cells when it divides, while an embryo will give rise to the entire adult organism. Skin cells are not potential adults. Skin cells are potentially only more skin cells. Only embryos are potential adults.

Myth 10. BECAUSE FROZEN EMBRYOS MAY ONE DAY END UP BEING DISCARDED BY SOMEBODY, THAT MAKES IT ALLOWABLE, EVEN LAUDABLE, TO VIOLATE AND DESTROY THOSE EMBRYOS. The moral analysis of what we may permissibly do with an embryo doesn't depend on its otherwise "going to waste," nor on the incidental fact that those embryos are "trapped" in liquid nitrogen. Consider a radical case in which a group of children are permanently trapped in a schoolhouse through no fault of their own; that would not make it morally acceptable to send in a remote control robotic device which would harvest organs from those children and cause their demise.

About the Author:

After earning a Ph.D. in Neuroscience from Yale University, Rev. Dr. Tadeusz Pacholczyk did post-doctoral research at Mass. General Hospital/ Harvard Med. School. He later studied in Rome where he did advanced studies in theology and in bioethics. He has testified at state legislative hearings, and given presentations on stem cells, cloning and other biotechnologies throughout the U.S. and in Europe. He serves as Director of Education for the National Catholic Bioethics Center in Philadelphia and is a priest in the diocese of Fall River, Massachusetts. Visit *www.ncbcenter.org* for further information.