



House Health and Human Services Committee

Monday, February 12, 2007

HB 2255

An Act concerning human cloning; prohibiting certain expenditures of moneys appropriated from the state treasury by state agencies

Neutral Testimony Offered by the University of Kansas Medical Center

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Testimony

Madam Chair, members of the committee, I am submitting neutral testimony today on HB 2255. Similar to my testimony on HB 2098 last week, this statement is meant to provide an objective, scientific perspective in the stem cell research policy debate. Currently I serve as Vice Chancellor for Research at the University of Kansas Medical Center (KUMC). As a scientist with considerable expertise in biology and reproductive sciences, I will point out the potential consequences of HB 2255.

First of all, HB 2255 defines human cloning as, “human asexual reproduction, accomplished by introducing nuclear material from one or more human somatic cells into a fertilized or unfertilized oocyte whose nuclear material has been removed or inactivated to produce a living organism at any stage of development with a human or predominantly human genetic constitution that is genetically virtually identical to an existing or previously existing human organism.” This would ban human therapeutic cloning using somatic cell nuclear transfer (SCNT) because of the phrase “at all stages of development.”

Human therapeutic cloning is the production of stem cells for directive development of specific cell types such as heart cells, bone cells, and nerve cells. The inability of Kansas scientists to perform human therapeutic cloning with SCNT technology will adversely compromise research in our state. University and biotechnology research using therapeutic cloning methods of SCNT will be stymied. My colleagues and I want to be sure you understand that the HB 2255 definition of human cloning lumps together reproductive and therapeutic cloning, thus blocking all cloning using SCNT.

Faculty who wish to utilize these techniques will not be able to pursue lines of investigation that could lead to cures, grants, and knowledge regarding early development. This knowledge could be particularly useful in researching reasons for developmental disabilities. You also need to be aware that recruitment of scientific faculty by our universities and attraction to Kansas of biotechnology companies requiring this technology would be dealt a terrible blow if this legislation became law. In addition, faculty would be limited in their ability to collaborate with other universities outside of Kansas in this area.

Next, the term “asexual reproduction” in human cloning implies that a human individual is being produced. This is not the case for therapeutic cloning using SCNT since the cells will never be placed in a uterus. You should also be aware that the term “asexual reproduction” is not commonly used in scientific literature to refer to humans, but instead is primarily a term reserved for plants and invertebrates.

It is useful to look at the federal policy on stem cells. On August 9, 2001, President George W. Bush announced the U.S. policy on embryonic stem cell research. This policy states that cell lines are eligible for federal funds if:

- “The derivation process (which begins with the destruction of the embryo) was initiated prior to 9:00 P.M. EDT on August 9, 2001.
- The stem cells must have been derived from an embryo that was created for reproductive purposes and was no longer needed.
- Informed consent must have been obtained for the donation of the embryo and that donation must not have involved financial inducements.”

Currently, two KUMC researchers are conducting stem cell research using stem cell lines approved by President Bush. This research is supported by grant funds from the National Institutes of Health (NIH). Because of the importance of NIH grant funds to biomedical research not just at KUMC but nationwide, I encourage you to carefully consider the implications of state laws that are more restrictive than federal policies.

Again, KUMC is neutral on HB 2255, but my colleagues and I do want to be sure you have all of the scientific facts as you proceed. As an appendix to this testimony, I have included the National Academies of Sciences glossary of terms from the 2005 peer-reviewed report on human embryonic stem cell research. Please contact me if you need further information.

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Appendix

National Academies of Sciences Definitions

- **Adult stem cell**—An undifferentiated cell found in a differentiated tissue that can renew itself and (with limitations) differentiate to yield the specialized cell types of the tissue from which it originated.
- **Autologous transplant**—Transplanted tissue derived from the intended recipient of the transplant. Such a transplant helps to avoid complications of immune rejection.
- **Blastocoel**—The cavity in the center of a blastocyst.
- **Blastocyst**—A preimplantation embryo of 50–250 cells depending on age. The blastocyst consists of a sphere made up of an outer layer of cells (the trophoctoderm), a fluid-filled cavity (the blastocoel), and a cluster of cells on the interior (the inner cell mass).
- **Blastomere**—A single cell from a morula or early blastocyst, before the differentiation into trophoctoderm and inner cell mass.
- **Chimera**—An organism composed of cells derived from at least two genetically different cell types. The cells could be from the same or separate species.
- **Differentiation**—The process whereby an unspecialized early embryonic cell acquires the features of a specialized cell, such as a heart, liver, or muscle cell.
- **Ectoderm**—The outermost of the three primitive germ layers of the embryo; it gives rise to skin, nerves, and brain.
- **Egg cylinder**—An asymmetric embryonic structure that helps to determine the body plan of the mouse.
- **Electroporation**— Method of introducing DNA into a cell.
- **Embryo**—An animal in the early stages of growth and differentiation that are characterized by cleavage, laying down of fundamental tissues, and the formation of primitive organs and organ systems; especially the developing human individual from the time of implantation to the end of the eighth week after conception, after which stage it becomes known as a fetus.*
- **Embryoid bodies (EBs)**—Clumps of cellular structures that arise when embryonic stem cells are cultured. Embryoid bodies contain tissue from all three germ layers: endoderm, mesoderm, and ectoderm. Embryoid bodies are not part of normal development and occur only in vitro.
- **Embryonic disk**—A group of cells derived from the inner cell mass of the blastocyst, which later develops into an embryo. The disk consists of three germ layers known as the endoderm, mesoderm, and ectoderm.

- **Embryonic germ (EG) cells**—Cells found in a specific part of the embryo or fetus called the gonadal ridge that normally develop into mature gametes. The germ cells differentiate into the gametes (oocytes or sperm).
- **Embryonic stem (ES) cells**—Primitive (undifferentiated) cells derived from the early embryo that have the potential to become a wide variety of specialized cell types.
- **Endoderm**—Innermost of the three primitive germ layers of the embryo; it later gives rise to the lungs, liver, and digestive organs.
- **Enucleated cell**—A cell whose nucleus has been removed.
- **Epidermis**—The outer cell layers of the skin.
- **Epigenetic**— Refers to modifications in gene expression that are controlled by heritable but potentially reversible changes in DNA methylation or chromatin structure without involving alteration of the DNA sequence.
- **Epithelium**—Layers of cells in various organs, such as the epidermis of the skin or the lining of the gut. These cells serve the general functions of protection, absorption, and secretion, and play a specialized role in moving substances through tissue layers. Their ability to regenerate is excellent; the cells of an epithelium may replace themselves as frequently as every 24 hours from the pools of specialized stem cells.
- **Fertilization**—The process whereby male and female gametes unite to form a zygote (fertilized egg).
- **Fibroblasts**—Cells from many organs that give rise to connective tissue.
- **Gamete**—A mature male or female germ cell, that is, sperm or oocyte, respectively.
- **Gastrulation**—The procedure by which an animal embryo at an early stage of development produces the three primary germ layers: ectoderm, mesoderm, and endoderm.
- **Genome**—The complete genetic material of an organism.
- **Genotype**— Genetic constitution of an individual.
- **Germ cell**—A sperm or egg or a cell that can become a sperm or egg. All other body cells are called somatic cells.
- **Germ layer**—In early development, the embryo differentiates into three distinct germ layers (ectoderm, endoderm, and mesoderm), each of which gives rise to different parts of the developing organism.
- **Germ line**—The cell lineage from which the oocyte and sperm are derived.

- **Hematopoietic**—Blood-forming.
- **Hematopoietic stem cell (HSC)**—A stem cell from which all red and white blood cells evolve and that may be isolated from bone marrow or umbilical cord blood for use in transplants.
- **Hepatocyte**—Liver cell.
- **Heterologous**—From genetically different individuals.
- **hES cell**—Human embryonic stem cell; a type of pluripotent stem cell.
- **Histocompatibility antigens**—Glycoproteins on the surface membranes of cells that enable the body's immune system to recognize a cell as native or foreign and that are determined by the major histocompatibility complex.
- **Homologous recombination**—Recombining of two like DNA molecules, a process by which gene targeting produces a mutation in a specific gene.
- **Hybrid**— An organism that results from a cross between gametes of two different genotypes.
- **Immune system cells**—White blood cells, or leukocytes, that originate in the bone marrow. They include antigen-presenting cells, such as dendritic cells, T and B lymphocytes, macrophages, and neutrophils, among many others.
- **Immunodeficient mice**—Genetically altered mice used in transplantation experiments because they usually do not reject transplanted tissue.
- **Immunogenic**—Related to or producing an immune response.
- **Immunosuppressive**— Suppressing a natural immune response.
- **Implantation**—The process in which a blastocyst implants into the uterine wall, where a placenta forms to nurture the growing fetus.
- **Inner cell mass**—The cluster of cells inside the blastocyst that give rise to the embryonic disk of the later embryo and, ultimately, the fetus.
- **Interspecific**—Between species.
- **In utero**—In the uterus.
- **In vitro**—Literally, “in glass,” in a laboratory dish or test tube; in an artificial environment.

- ***In vitro* fertilization (IVF)**—An assisted reproductive technique in which fertilization is accomplished outside the body.
- ***In vivo***—In the living subject; in a natural environment.
- **Karyotype**—The full set of chromosomes of a cell arranged with respect to size, shape, and number.
- **Leukemia inhibitory factor (LIF)**—A growth factor necessary for maintaining mouse embryonic stem cells in a proliferative, undifferentiated state.
- **Mesenchymal stem cells**—Stem cells found in bone marrow and elsewhere from which a number of cell types can arise, including chondrocytes, which produce cartilage, and fibroblasts, which produce connective tissue.
- **Mesoderm**—The middle layer of the embryonic disk, which consists of a group of cells derived from the inner cell mass of the blastocyst; it is formed at gastrulation and is the precursor to bone, muscle, and connective tissue.
- **Morula**—A solid mass of 16–32 cells that resembles a mulberry and results from the cleavage (cell division without growth) of a zygote (fertilized egg).
- **Neural stem cell (NSC)**—A stem cell found in adult neural tissue that can give rise to neurons, astrocytes, and oligodendrocytes.
- **Nuclear transfer (NT)**—Replacing the nucleus of one cell with the nucleus of another cell.
- **Oocyte**—Developing egg; usually a large and immobile cell.
- **Phenotype**—Visible properties of an organism produced by interaction of genotype and environment.
- **Placenta**—The oval or discoid spongy structure in the uterus from which the fetus derives its nourishment and oxygen.
- **Pluripotent cell**—A cell that has the capability of developing into cells of all germ layers (endoderm, ectoderm, and mesoderm).
- **Precursor cells**—In fetal or adult tissues, partly differentiated cells that divide and give rise to differentiated cells. Also known as progenitor cells.
- **Preimplantation genetic diagnosis (PGD)**—A procedure applied to IVF embryos to determine which ones carry deleterious mutations predisposing to hereditary diseases.
- **Primary germ layers**—The three initial embryonic germ layers—endoderm, mesoderm, and ectoderm—from which all other somatic tissue types develop.

- **Primordial germ cell**—A cell appearing during early development that is a precursor to a germ cell.
- **Primitive streak**—The initial band of cells from which the embryo begins to develop. The primitive streak establishes and reveals the embryo's head-tail and left-right orientations.
- **Pseudopregnant**—Refers to a female primed with hormones to accept a blastocyst for implantation.
- **Somatic cells**—Any cell of a plant or animal other than a germ cell or germ cell precursor.
- **Somatic cell nuclear transfer (SCNT)**—The transfer of a cell nucleus from a somatic cell into an egg (oocyte) whose nucleus has been removed.
- **Stem cell**—A cell that has the ability to divide for indefinite periods in vivo or in culture and to give rise to specialized cells.
- **Teratoma**—A tumor composed of tissues from the three embryonic germ layers. Usually found in ovary or testis. Produced experimentally in animals by injecting pluripotent stem cells to determine the stem cells' abilities to differentiate into various types of tissues.
- **Tissue culture**—Growth of tissue *in vitro* on an artificial medium for experimental research.
- **Transfection**—A method by which experimental DNA may be put into a cultured cell.
- **Transgene**—A gene that has been incorporated into a cell or organism and passed on to successive generations.
- **Transplantation**—Removal of tissue from one part of the body or from one individual and its implantation or insertion into another, especially by surgery.
- **Trophectoderm**—The outer layer of the developing blastocyst that will ultimately form the embryonic side of the placenta.
- **Trophoblast**—The extraembryonic tissue responsible for negotiating implantation, developing into the placenta, and controlling the exchange of oxygen and metabolites between mother and embryo.
- **Undifferentiated**—Not having changed to become a specialized cell type.
- **Xenograft or xenotransplant**—A graft or transplant of cells, tissues, or organs taken from a donor of one species and grafted into a recipient of another species.
- **Zygote**—A cell formed by the union of male and female germ cells (sperm and egg, respectively).