DEBATINGSCIENCEISSUES

Stem Cell Research

Debate motion

This house proposes that the potential benefits of using embryonic stem cells to develop new medical treatments mean we have a moral obligation to support this type of research.

Stem cell research

The dominant view in the scientific community is that stem cell research has great scientific and medical promise for the understanding and treatment of a wide range of human diseases (Brock 2006). Scientists believe it should be possible to use stem cells to:

- study how body tissues develop and how disease takes hold.
- test the effects of experimental drugs on pure populations of specific differentiated cells, e.g. cardiac muscle cells.
- deliver gene therapy.
- generate healthy tissue and organs, which are genetically matched to patients, to replace damaged or diseased tissue.
- help develop cures for Parkinson's disease, Alzheimer's, stroke, arthritis, burns, spinal injury, multiple sclerosis, heart disease, diabetes and even perhaps some forms of cancer.

On the other hand, using stem cells for therapeutic purposes may have potential risks that:

- viruses and other disease causing agents are passed on to people who receive cell transplants.
- nutrients from animal sources currently used to cultivate stem cells could possibly pass disease on to humans.
- stem cells may possibly turn cancerous.

There are also several ethical concerns related to stem cell research, which we discuss below.

Stakeholders

The practice and progress of stem cell research involves many parties:

- Healthcare providers: research may bring therapeutic solutions for many diseases.
- Patients: research may find cures for diseases to alleviate suffering and loss of life.
- Consumers: non-therapeutic products may also be developed, e.g. anti-aging products.
- Regulatory bodies.
- Research funding bodies.
- Scientific and clinical researchers.
- Industries such as pharmaceutical companies, who will gain financially.
- National Economies stand to gain if globally competitive in research.
- Ethicists.

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Adult cells are differentiated to fulfil a particular purpose which cannot be changed. For example, a liver cell cannot suddenly fulfil heart cell functions. Stem cells, however, retain the potential to develop into other types of human body cells, and of replicating indefinitely. Large numbers of stem cells are needed for research and stem cell replacement therapies.

Embryonic stem cells are believed to have the greatest potential for curing diseases because they can generate every cell type in the body. These cells are pluripotent, which means that each cell can develop into all the different types of cells needed for a complete and functioning organism. Large numbers of embryonic stem cells can be grown relatively easily in culture; these are called stem cell lines. These stem cell lines are also pluripotent; they are able to give rise to most tissue types, but not capable of bringing a functioning organism into existence. Embryonic stem cells are far more readily available than other types, pose less risk of DNA abnormalities and have the greatest potential for growth and specialization.

Adult (tissue) stem cells are found within adult organs, e.g. bone marrow cells, and have the potential to become any of the major specialized cell types within that organ, to repair any damage. These are described as multipotent; they can give rise to a limited number of tissue types. For example, bone marrow cells can give rise to bone, fat and cartilage. Neural stem cells can give rise to neurons, astrocytes and oligodendrocytes. Tissue stem cells have the advantage, however, that (theoretically) if grown in culture from cells sourced from a patient, they can be re-transplanted into the patient without invoking the immune system. The number of stem cells in an organ is limited; in bone marrow only one in every 10,000 to 15,000 cells is a stem cell. Methods to develop them in the lab in sufficient numbers are still being developed. Tissue stem cells have a higher chance of genetic mutation caused by exposure to a variety of external factors such as UV rays and toxins.

Foetal stem cells can be sourced from the umbilical cord blood, or from foetal tissue following pregnancy termination. Umbilical cords give only a small volume of blood, and stem cells present in the blood can only differentiate into a limited number of cell types; foetal stem cells have limited availability, but the potential to differentiate into many cell types.

Inducible pluripotent stem cells (iPS cells) are a relatively recently discovered type of stem cell. Technology developed in 2007 allowed scientists to reprogramme adult human cells to a pluripotent state, making them similar to embryonic stem cells in terms of research and therapeutic applications. These iPS cells are genetically modified by the integration of up to four DNA-transcription factors into the adult cell genome. iPS cells can be generated from a wide variety of adult cells. Although the first versions of iPS cells were riddled with viruses, researchers have now managed to make them virus-free. However, they do not proliferate at the same rate as embryonic stem cells, meaning that their usage may be limited.

Therapeutic cloning

Therapeutic cloning can overcome the problem of transplanted stem cells being rejected by the body. The nucleus of an embryonic stem cell is removed and replaced with the nucleus of one of the patient's cells, such as a skin cell. The resultant cell lines are genetically identical to the patient. In the future it may be possible to grow complete donor-compatible organs.

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Reproductive cloning

Reproductive cloning involves taking a cell from an adult human to create an embryo that is allowed to develop into a fully formed baby. There is some public concern that perfecting cell nuclear transfer with therapeutic cloning may lead to reproductive cloning; however, according to experts, embryos created with this technique are rarely viable. Reproductive cloning has been prohibited in a resolution by the United Nations.

IVF

In Vitro Fertilization (IVF) is a laboratory procedure to help couples to have a baby. Sperm are placed with an unfertilized egg in a Petri dish to achieve fertilization. The embryo is then transferred into the uterus to begin a pregnancy, or frozen for future use.

Stem cell banks

SWEDEN has recently established a national stem cell bank for umbilical cord stem cells.

SPAIN has the Stem Cell Bank of Barcelona (BLCB), which is a functional unit of the Centre of Regenerative Medicine in Barcelona (CMR[B]). The BLCB is dedicated to the derivation, maintenance, characterisation and preservation of embryonic stem cells, with the aim of developing research activities in the area of regenerative medicine.

ENGLAND AND SCOTLAND utilise the UK Stem Cell Bank, which is hosted by the National Institute of Biological Standards and Control. It has two functions: to store adult, foetal and embryonic stem cell types and to supply cell lines for basic research and clinical applications. The Bank accepts both stem cell lines developed in the UK and appropriately accredited lines created in other countries.

There is currently no stem cell bank in IRELAND, while in FRANCE and ITALY it is unlawful to store family cord blood.

Ethical questions

What happens in nature and what is already accepted in society?

There are several examples where ‘natural wastage’ of embryos appears to be generally accepted in society. One example is that many surplus embryos created during IVF treatment are stored in freezers and eventually destroyed. This raises the question of whether there is a moral distinction between destroying embryos in research and destroying them following IVF treatment. Another example is the use of contraceptive methods which prevent embryo development, such as intrauterine devices (IUDs) and the morning after pill. Abortion also results in destruction of embryos and even with normal sexual reproduction, it’s estimated that for each embryo that develops to birth, three fail to do so (see ‘Facts and Figures’ on accepted embryo losses).

What is the moral status of an embryo?

To derive embryo stem cells requires collecting cells from the part of the embryo called the inner cell mass at around 5-7 days after fertilization (the blastocyst stage). Collecting these cells destroys the embryo. All embryos, whether created in the laboratory or naturally, may have the potential to develop into a fully grown

human being, if implanted in a uterus. This raises the question of whether it's correct to cause destruction of an embryo to derive embryo stem cells. Your views on this depend on how you perceive the moral status of a human embryo. If you believe that the moral status of an embryo is the same as a fully grown human being, you may feel that destruction of an embryo is equivalent to the murder of a fully grown adult. If you feel that an embryo is just a ball of cells with no moral status of its own, you may feel that the means (embryo destruction) justifies the ends (potential relief of human suffering and prevention of death).

Is there a pre-moral status phase?

Rather than the binary decision that an embryo does or doesn't have the equivalent rights to a full grown adult, another view is that the moral status of the embryo develops with time. From the view that moral rights develop by gradual stages after fertilization, follows the possibility that it might be ethical to use embryos for research up until a certain time. This raises the question at what point should an embryo be awarded the status of a human being? UK legislation limits research on embryos to 14 days after conception. No visible organization of the embryo happens before this point.

Human rights of the embryo, or needs of the many?

In view of the potential scientific value of stem cell research to health care and human suffering, do the rights of the embryo outweigh the rights of the adults and children with incurable diseases? Is it ethical to focus medical research on obtaining stem cells from adults, if in the meantime people die of diseases that embryonic stem cells could cure? See also the statistics for disease and disability which could be reduced through stem cell research under Facts and Figures below. If you feel that the needs of the many outweigh the rights of the embryo, and you condone embryo stem cell research, do you condone it for therapeutic purposes only, or also for non-therapeutic purposes, such as the development of 'anti-ageing' treatments?

Is creating embryos for research unethical?

Is it acceptable to create an embryo, solely for the purpose of research, which will cause its destruction? If you believe that an embryo has a moral status equal to a human being, creating embryos for research violates the Kantian principle that we should never treat other people solely as a means to an end, because it uses the embryo as a mere commodity. However, if you feel that at the blastocyst stage, the embryo lacks any of the properties that would make it a rational agent with interests or purposes of its own, the Kantian principle would not apply.

Is stem cell research economically interesting?

The high expense of stem cell research raises the question of whether the benefits outweigh the costs. Current costs of ill health to the economy can be categorized into healthcare costs, productivity costs and informal care costs. The value in terms of human life and suffering cannot be equated monetarily. The value to national economies is not only in reduction of estimated costs, or reduced suffering, however. Pharmaceutical companies, for example, perceive the national economic value in maintaining UK and Ireland as global scientific competitors.

Facts and Figures

Socially accepted embryo losses:

- 15% of fertilised eggs are lost before the egg even has a chance to implant in the wall of the uterus.
- Only around 10% of transferred IVF embryos produce a baby (Winston 2001).

IVF surplus: Many frozen embryos are left over from IVF treatment, which could be made available for research – for example a surplus of over 1.2 million has been estimated between 1991 and 2005 in the UK, most of which were destroyed within days of creation.

Diseases for which stem cell research may have potential:

Cancer: Every year, 3.2m Europeans are diagnosed with cancer - the most common cause of death after heart disease. Most widespread are cancers of the lungs, breast and colon. It is the second most common cause of death in Europe (29% of deaths for men, 23% for women). (European Commission).

Heart disease: Diseases of the heart and circulatory system are the largest single cause of death in the EU, accounting for about 2 million deaths in the European Union, as well as being responsible for the largest number of premature deaths before the age of 75 years.(European Commission)

Neurodegenerative disorders: These disorders, which include Alzheimer's disease and Parkinson's disease, are mainly linked to age, and the proportion of the European population aged over 65 is likely to rise to 25% by 2030 (from 16% today). (Neurodegenerationresearch.eu).

Multiple Sclerosis: Estimates of the number of people affected by Multiple Sclerosis throughout the world range between 1.1 million and 2.5 million. While no data on prevalence or incidence in the EU have been systematically collected, except some local or regional surveys, the number of people affected is estimated to be around 500,000 in the EU-27. (European Commission)

Diabetes: It was estimated that some 53 million people in the European Region have diabetes. The European region has the second highest rate of diabetes prevalence in the world at 8.4%. (International Diabetes Federation Europe).

Musculoskeletal conditions: Arthritis affects almost 3 million Europeans. Total joint replacement (mainly of the hip or knee) is one of the most common elective operations for older people in most European countries. (Rheumatology Information Service Europe)

Cloning: In 2004, 35 countries had adopted laws forbidding human cloning, although some allow the creation of cloned human embryos for research (WHO). In 2005, the UN General Assembly adopted a resolution to prohibit all forms of human cloning in the Member States (59/280 UN Declaration on Human Cloning.) There are, however, organizations totally committed to human cloning: see http://www.clonaid.com and http://www.humancloning.org.

Legislation and Regulatory Authorities

Currently, there is no international consensus on embryo research or therapeutic cloning, and European nations vary in their legislation. Most stem cell research in Europe is carried out with tissue stem cells and funded at a national level – Belgium, Sweden, Spain, Ireland and the UK are heavily involved in this research.

In July 2006, European Ministers agreed to fund some elements of human embryonic stem cell research. It was agreed among the member states that destruction of the human embryo would not be supported financially but the subsequent steps in the research could be funded through the Framework Seven research programme for scientists in the EU countries where it is legal.

In the UK, under the Human Fertilization and Embryology Act (1990), and an extension in 2001, it is legal to carry out research on human embryos up to 14 days after fertilization to help understand the development of embryos, or to help understand and treat serious disease.

Ireland is the only country of the EU whose Constitution affirms the right to life of the 'unborn' and that this right is equal to that of the mother. The Commission on Assisted Human Reproduction report in 2005 recommended that embryo research be allowed up until 14 days after fertilization on surplus embryos donated specifically for research, and that producing embryos specifically for research purposes should be prohibited. No legislation has been put in place in this area since then. In Ireland, only adult (tissue) – not embryo – stem cell research is carried out.

Italy has a 2004 law that forbids all sperm or egg donations and the freezing of embryos, but allows, in effect, using existing stem cell lines that have been imported.
France prohibits reproductive cloning and embryo creation for research purposes, but their legislation allows scientists to conduct stem cell research on imported surplus embryos from IVF treatments.

Sweden has made provisions for the legal creation of embryos for research purposes.

Germany, Austria, Finland, Greece, Portugal and the Netherlands prohibit or severely restrict the use of embryonic stem cells in research.

Religious influences

The question over whether an embryo deserves the respect and protection of a human person from the time of conception varies between religions. Some religions believe that the embryo is created by God and is a person in its own right with the same moral status as an adult human from the moment of conception. Other religions perceive acquiring full personhood, and the moral rights that go with this status, as gradual during the process of development between conception and birth. It follows from this belief that it might be ethically acceptable under certain circumstances to use embryos for research.

Additional Sources and Further Reading

EuroStemCell: Europe's stem cell hub: Providing reliable, independent information and road-tested educational resources on stem cells and their impact on society. Funded by the European Commission. www.eurostemcell.org

"Stem cells: current action, research and funding in Europe – Roundtable" December 2008
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European Commission Public Health – Major and Chronic diseases
http://ec.europa.eu/health/major_chronic_diseases/diseases/index_en.htm

Rheumatology Information Service Europe (RISE)
http://www.kineret-eu.com/en/pro/rhe/rhepre.jsp

Joint Programme on Neurodegenerative Disease Research
http://www.neurodegenerationresearch.eu/