Issues and ethics of human embryos generated from reprogramed cells

Original publiction:
Human embryos from iPSC-derived gametes: ethical and quality considerations

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Induced pluripotent stem cells give researchers the ability to make any other cell in the body, including reproductive sperm and egg cells. Science and medicine benefit from studying sperm and egg formation, but using stem cell-derived sperm and eggs to form embryos raises many questions. Discussion between researchers and the public is essential to address ethical questions, scientific implications and the current status of stem cell-derived embryos.

What questions & challenges are raised?

Induced pluripotent stem cells (iPSCs) have opened up numerous opportunities for therapeutic treatments as well as research into the basis of human biology and development. iPSCs have the ability to be created from any cell in the body and then be differentiated back into any type of cell, including sperm and egg cells. This raises many ethical concerns about creating embryos from iPSC-derived reproductive cells, but also offers many opportunities to learn about the development of sperm, eggs and embryos. In their recent publication, Dr Dusko Ilic of King's College London and his colleagues discuss the many ethical issues, benefits, and current technical limitations of creating iPSC-derived reproductive cells and embryos. While debate and discussion of ethical issues is good, there have been many articles in the media that detrimentally stir debate on this subject. Such articles can lead to misunderstandings of current technologies, cause suspicion of iPSC research and prevent the public from seeing the benefits of such research. Ethical studies of iPSC-derived reproductive cells and embryos offer researchers an opportunity to better understand reproductive cell formation, causes of infertility, and many details important for the earliest stages of life.

What insight & direction does this give for research policies?

Research in iPSC-derived reproductive cells has many implications, such as understanding how sperm and eggs are formed, studying the earliest stages of embryo growth, and treating infertility. This technology and research does raise ethical issues, which should be openly discussed between the public and researchers to help prevent misinformation and public suspicion. Some aspects of iPSC technology will soon allow researchers to create human embryos from iPSC-derived sperm and eggs. However, Dr Ilic and colleagues point out that just because researchers have the technology doesn't mean it is fully understood or that it will be used in IVF clinics. Introducing iPSC technology into IVF clinics would require big changes to current legislation, broad public discussion and support, further research to understand and develop the technology, and establishing many different safety standards. For now, researchers must exercise caution and the public should know that pregnancies from iPSC-derived sperm and eggs remain very unlikely for the foreseeable future.

What background and point are discussed?

Several research teams have successfully turned iPSCs into both mouse sperm and eggs, but, as Dr Ilic and his colleagues point out, much of the biological process remains a "black box". Researchers still rely on mature cells from adult animals (somatic cells) to help provide the right growing environment and factors to finish making sperm or eggs. Although not fully understood, mouse iPSC-derived reproductive cells are able to form healthy pups. These technologies are not yet possible for humans, but are getting closer. Nearly all countries have legislation in place that strictly regulates in vitro fertilization (IVF), so it is highly unlikely any country will permit pregnancies with iPSC-derived cells. None-the-less, the authors identify and discuss several of the ethical issues surrounding this research. One significant issue raised is that donors of cells and tissues should know and consent to how their donations will be used. The authors state that creating iPSC-derived sperm, eggs and potentially embryos warrants explicit consent from donors to use their cells. Ethical concerns about using iPSC-derived reproductive cells to create 'designer babies', practice eugenics or rapidly evolve human traits in a dish are largely unfounded. Researchers don't know all the genes and other genetic and epigenetic factors needed for specific human traits, making the selection of traits currently impossible. iPSC-derived reproductive cells could allow researchers to rapidly produce multiple generations of human cells in a dish. However, lab-dish evolution of human traits is unfounded because the environment of an organism greatly impacts how it evolves; a person's environment will certainly be different than that of cells in a lab dish. The last and most detailed part of the authors' paper discusses methods that might be used to determine if iPSC-derived reproductive cells are healthy and fully functional. Being able to make 'normal' reproductive cells from iPSCs will greatly help researchers understand infertility, diseases, disorders, and problems that occur early on in human development. The authors suggest the only real way to judge 'normality' of reproductive cells is to examine the similarities and differences between fertilized eggs using natural and iPSC-derived sperm and eggs. Dr Ilic and colleagues discuss several methods that researchers might use to do this, such as; using rapid time-lapse imaging to monitor physical shape; screening for chromosome and DNA sequence abnormalities; analysis of the different genes being expressed; examining what epigenetic factors are present and required; and understanding what molecules are being produced and released by the cells.