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Case: Mitochondrial Transfer Therapy as Enhancement Technology

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Year

2016

Description

This case describes the February 2015 decision by the United Kingdom's Parliament to allow human trials of an in vitro fertility (IVF) treatment using mitochondrial transfer technologies. It provides an opportunity for discussion of the ethics of germline gene modification in humans as both therapy and enhancement.

Body

In February 2015, the United Kingdom's Parliament voted to allow human trials of an *in vitro* fertility (IVF) treatment using mitochondrial transfer technologies. [1] These technologies are aimed at preventing the transmission of mitochondrial disease from pregnant women to their offspring.

Mitochondrial disease is an umbrella term that comprises a set of conditions with varying degrees of severity, including neurodegenerative disease, epilepsy, stroke-like episodes, blindness, diabetes, and deafness, among others. These conditions share a common origin of dysfunctional mitochondria, the energy-producing organelles found in cells. These organelles carry their own DNA, approximately 37 genes and less than 0.1% of the human genome. There is some disagreement about

the prevalence of mitochondrial disease. However, it is estimated that 1 in 400 people carry a mitochondrial mutation that may cause disease, and that 1 in 6500 babies are born with some kind of mitochondrial disorder (Dimond 2015; Sample 2013). More importantly, there is a wide spectrum of symptoms of the disease, and they can range from mild to severe.

The UK government considered and approved two different techniques of mitochondrial transfer in IVF procedures, pronuclear transfer and maternal spindle transfer. Pronuclear transfer occurs after fertilization and involves the transfer of the pronuclei from the zygote with the dysfunctional mitochondria into the enucleated donor zygote with functional mitochondria. Maternal spindle transfer involves a similar process of transfer, in which the spindle of the chromosomes from an unfertilized egg with dysfunctional mitochondria is transfer into an enucleated egg cell with functional mitochondria (Baylis 2013; Dimond 2015).

The UK government's decision was preceded by a report from the Nuffield Council on Bioethics, published in June 2012, and a review from the Human Fertilisation and Embryology Authority (HFEA). [2]

The Nuffield Council judged that the procedures were ethical and would allow women to have healthy, genetically-related children, who otherwise could not. Additionally, the Council described the IVF methods as germline genetic therapy, but claimed that any resulting children from these procedures should not be considered "three-parent babies" and the mitochondrial donors should not be identifiable. They did, however, recommend that adult children born from these procedures participate in long-term health check-ups to provide more information on the long-term consequences of these therapies.

The HFEA further assessed the safety and efficacy of the proposed techniques and judged that they were "not unsafe" and suggested that the public was generally supportive of the procedures. Before this decision, the HFEA did not allow any therapies or techniques that altered the DNA in human embryos.

The fact that this therapy has been described as germline gene modification with heritable consequences for future generations has led many critics to caution that such interventions may easily lead to non-therapeutic applications - in other words, *enhancement*. For example, some have already pointed out that the intervention could be desirable to lesbian couples who want to be both genetically related to

their child, or perhaps to older women to address age-related infertility. Given these prospective applications, legislative and regulatory bodies should be aware of the potential slippery slope towards the creation of designer babies.

Discussion Questions

- What reasoning supports the Nuffield Council's dismissal of the idea that children born from these therapies are "three-parent babies"? What are some counter-arguments? What might be some of the social and ethical implications of identifying the prospective children born from these therapies as "three-parent babies"?
- Some proponents of these therapies, such as Julian Savulescu, chair of the Oxford Uehiro Centre for Practical Ethics at the University of Oxford, have compared mitochondrial transfer technology to organ transplantation or tissue donation, and argued that the minimal amount of DNA found in mitochondria is not important because it does not contribute to the "ethically important characteristics of the child." Is the exact nature of the genetic contribution of mitochondrial DNA to a child's characteristics morally relevant? Might there be other reasons why these techniques, described as germline gene therapies, might be ethically problematic?
- How might these therapies affect the reproductive choices of individuals? Should they be available to prospective parents who do not carry any disease-linked mitochondrial mutations, such as older women or lesbian couples who want to be both genetically related to their child? Why/why not?
- Are there morally salient differences between the two proposed IVF techniques for mitochondrial replacement?

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- [1]These technologies are also sometimes referred to as "mitochondrial replacement" and "mitochondrial manipulation."
- [2]The Nuffield Council on Bioethics is an independent body in the UK that addresses and reports on ethical issues in biology and medicine. "It was

established by the Trustees of the Nuffield Foundation in 1991, and since 1994 it has been funded jointly by the Foundation, the Wellcome Trust and the Medical Research Council." See more at: http://nuffieldbioethics.org/. The HFEA is an executive body of the UK's Department of Health and oversees "the use of gametes and embryos in fertility treatment and research." See more at: http://www.hfea.gov.uk/

Notes

This material is based upon work supported by the National Science Foundation under Award No. 1355547, Karin Ellison and Joseph Herkert, Arizona State University sub-award Co-PIs. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

The author wishes to acknowledge the contributions of Karin Ellison, OEC - Life and Environmental Sciences Editor, and Joseph Herkert, OEC Engineering co-Editor. They provided valuable input in selecting topics and crafting the resources.

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