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Gene editing embryos may lead to 'pursuit of a conception of perfection'

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Credit: Northeastern University

Last week, scientists published a study that overcame a massive hurdle in the quest to eradicate dangerous genetic diseases. By employing the CRISPR-Cas9 gene editing method on human embryos, researchers for

the first time successfully fixed a mutation known to cause an often fatal heart condition.

With this technology, hereditary diseases could be stopped in their tracks. Not only would the embryos from this study have developed into healthy babies, they also would have passed their newly engineered healthy genomes along to offspring.

The breakthrough is an important step, but researchers are far from ready to use the technology in a clinical setting. Still, the ability to safely and successfully retool a human embryo has profound medical and philosophical implications. Critics have argued that gene editing is a slippery slope, one that could lead to "designer babies" genetically engineered for desirable traits. Proponents contend that any technology with the power to ease human suffering should be fully embraced.

To understand the significance of this research, we called asked three Northeastern professors to answer questions about the ethics, science, and potential consequences of human gene editing.

How difficult is it to do this type of gene editing successfully? Even with the use of CRISPR, the process must be incredibly complex.

James Monaghan, assistant professor of biology: The study demonstrated the feasibility of fixing a genetic defect in a human embryo. Although scientifically an impressive feat, it is far from straightforward to perform such gene editing techniques. Many fewer labs than the public may realize have the capability to pull this off as they did. Yes, CRISPR has made gene editing orders of magnitude more accessible to the researcher. But, imagine how difficult it is for any approach to cut one DNA base pair out of the 3 billion in the genome, and do it without error

every time. That is what would be needed—hopefully—before human genome editing would ever go to clinic.

What ethical concerns does work raise?

John Basl, professor of philosophy: There are a host of ethical concerns that have been raised about genetic engineering generally, and some ethical concerns that arise only in the context of germline engineering, or genetic engineering where the engineered genome can be passed on to offspring, as was accomplished in this breakthrough. The primary concern with germline engineering is that if there are deleterious modifications, they could spread. If germline modification becomes widespread, deleterious modifications could, I suppose, result in disease epidemics. The chance of this occurring is a function of how well scientists understand the genome and how careful they are in their modifications. It also depends on germline modification becoming very widespread.

What do you make of the argument that genetic engineering is morally wrong?

Basl: Some have argued that genetic engineering of almost any form is morally wrong on the grounds that it is unnatural, that it is an instance of human hubris, of our overstepping our limits or playing God. These concerns have received a lot of attention from ethicists and for the most part these arguments have been shown to be untenable. If we are to take seriously that genetic engineering is wrong because it is unnatural or an instance of playing God, one could argue that logic applies to all of modern medicine. But much of it is obviously good. And there seems to be good reason to think that something's being unnatural isn't a mark against it. So, I, and most ethicists working on these issues, don't think these are very serious concerns with genetic engineering.

Are there other valid concerns associated with genetic engineering?

Patricia Illingworth, professor of philosophy and business: In our society, people with disabilities are discriminated against and stigmatized. There is already increased intolerance of people who are different, or who are not "winners." It would not be surprising if people who have great wealth sought to use the technology in the pursuit of a conception of perfection. Thus exacerbating inequality in a society that is already unequal.

Basl: The more serious concerns about genetic engineering have to do with social justice. These concerns have various dimensions. One of these dimensions is distributive justice or how resources should be fairly allocated among people. If genetic engineering is expensive and gives individuals an advantage, then certain individuals will have greater access to advantage than others. There are many theories of distributive justice on which this is unfair. There are many goods in society that are competitive and those with more money typically have better access to those goods because they can, for example, afford more and better education. Genetic engineering might provide another means for those who already benefit from resource inequality to increase their access and share of competitive goods. On some theories of distributive justice, this is not a problem in itself, but on many of them this exacerbates or creates injustice.

What are some of the potential consequences of this technology?

Illingworth: The potential for good is that we could protect babies from getting inheritable diseases, such as breast cancer and sickle cell anemia, that cause a great deal of suffering. Families who are avoiding pregnancy because of the risk of an inherited disease would have more freedom.

One potential harm is that the technology if developed into germline editing will lead to the creation of designer babies in which the technology is used to enhance qualities such as intelligence, artistic and musical skills, and athleticism. These are great qualities, and they can be used for good, but they can also diminish diversity of talents, personalities and qualities in people. They can reduce tolerance of difference.

Now that we know gene editing of human embryos is on the horizon, how do we move forward? How will we govern the use of the technology?

Monaghan: It is tough to say if this paper will change much clinically. Not to undermine the incredible scientific hurdle and detail that went into this study, but it is one gene in a few embryos. There is a long way to go to human embryo editing. Clinically, a method called preimplantation genetic diagnosis currently has the capability of selecting an unmutated embryo during in vitro fertilization that would negate the requirement of gene editing. Also, without government funding in the study of human embryos, very few labs actually have enough private funding to perform such work in the United States.

Basl: In order to govern the use of genetic engineering so that the outcomes are ethical, or at least so that we mitigate the ethical costs of using the technology, we need to develop some mechanism of effective oversight. It would be nice to just decide on a set of rules about these technologies, such as that their therapeutic use is permissible but not otherwise, but the boundary between therapy and enhancement is difficult to draw. I also think it is a mistake to allow purely medical or scientific organizations to set standards for the use of technology. Addressing the challenges raised by these technologies is an interdisciplinary task.

Illingworth: It is important to be able to maximize the potential good of the technology and to minimize the risk of harm. It would be helpful if citizens participate in a public conversation about acceptable and unacceptable uses of gene editing. A social consensus is critical. In general, the potential for good is great, and the risks of harm associated with the technology can be managed through effective policy. Another concern is that the research is expensive and the benefits, especially early on, will be enjoyed mainly by the wealthy, those who can afford them. This puts health justice at further risk.

Provided by Northeastern University