CRISPR and the Ethics of Human Embryo Research

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News that U.S. scientists led by Oregon Health and Sciences University biologist Shoukrat Mitalipov have used the gene-editing technique known as CRISPR to modify the DNA of human embryos has led to renewed debate over human genetic engineering. Although scientists in China and the United Kingdom have already used gene editing on human embryos, the announcement that the research is now being done in the United States makes a U.S. policy response all the more urgent.

The scientists created 131 embryos that carried a genetic mutation that causes hypertrophic cardiomyopathy—a condition that can lead to sudden and unexpected heart attacks but has few other symptoms—and attempted to correct the mutation in 112 of them (leaving 19 as unmodified controls). By injecting the CRISPR complex together with the sperm cells that carried the mutation, rather than injecting CRISPR into already fertilized embryos, the scientists were able to successfully correct the mutated genes in 72 percent of the embryos. Whether the embryos were successfully or unsuccessfully treated, all were destroyed after the researchers were finished with the study.

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Much of the debate over CRISPR has been framed around concerns over the creation of so-called designer babies—children genetically engineered to possess desirable traits that will then be passed on to subsequent generations. Some science writers and journalists have tried to downplay these concerns by noting that the gene editing was done only for “basic research,” rather than as an attempt to create a genetically engineered human. Writing in The New York Times, Pam Belluck argued that even if scientists do modify the genes of human embryos, “fears that embryo modification could allow parents to custom order a baby with Lin-Manuel Miranda’s imagination or Usain Bolt’s speed are closer to science fiction than science.”

Those downplaying concerns also argue that preexisting practices such as the abortion of fetuses diagnosed with Down syndrome or the selective discarding of embryos diagnosed with genetic disease
through preimplantation genetic diagnosis (PGD) are exactly the reason gene-editing methods such as CRISPR will not be used on human embryos any time in the near future. As James Kath and Noam Prywes wrote in Scientific American, “the use of CRISPR, as explored in this study, has no clear advantage over PGD.” In a press release responding to the news, the Center for Genetics and Society, an advocacy group broadly opposed to genetic modification of human embryos, made a similar argument, noting that “preventing the transmission of serious inherited diseases does not require gene editing, since that can be avoided safely and in nearly every case with existing embryo screening techniques, where appropriate.” This is cold comfort, however, for those concerned about the destruction of human life for eugenic purposes, who might well consider gene editing to cure genetic disease in embryos as morally preferable to selectively killing embryos diagnosed with a genetic disease.

Although it’s true that CRISPR is unlikely to be used to prevent genetic disease, that doesn’t mean that it will never be used to modify human embryos. To screen for more complicated traits such as athletic ability, creativity, or intelligence—the sort that come up most often in discussion of designer babies—using methods like PGD won't work. Too many individual genes are involved in determining these traits for doctors to be able to pick one embryo that happens to have the right combination. Indeed, scientists have had difficulty identifying many of the genes associated with these traits. With the proper knowledge, however, gene-editing techniques like CRISPR could in principle be used to modify dozens or even hundreds of sites in the genome.

THE MORAL STATUS OF THE EMBRYO

Concerns that parents will one day treat children as products to be designed rather than human beings with their own interests and needs ignore what is most troubling about these experiments: the exploitation of unborn human beings.

The question of the moral status of the human embryo was widely debated in the United States during the early 2000s, when stem cell research, rather than genetic engineering, was the controversy of the day. Many Americans felt that human embryos were mere clumps of cells that could be destroyed by scientists for the sake of the promising medical innovations that might result. Others argued that life begins at conception and that, despite their very early stage of development, embryos were human beings and deserved at the very least not to be deliberately killed in scientific experiments. In short, making human beings for the sole purpose of killing them in scientific experiments was and is profoundly unjust.
Less is written about the moral status of the embryo today, perhaps because, after the promise of embryonic stem cell research failed to be realized, the public lost interest in this research and the moral questions it raised. But genetic engineering will make human embryo research more common in the years to come, not only for scientists such as Mitalipov who have the laudable goal of eventually providing ways to treat or prevent genetic disease, but also for researchers who are interested in experimenting on embryos simply to satisfy their scientific curiosity about the nature of human development.

Yet gene editing holds great promise for a wide range of therapies for genetic disease even if scientists never use it to modify human embryos. Gene therapy can be used on adults or children to treat or cure a variety of diseases, and there are myriad ways gene editing will be used to help scientists better understand disease. The technology is also being used in many other areas of biomedical research, such as the modification of pig genomes to make their organs more compatible for transplantation into human patients.

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Today, stem cell research can be carried out with either existing embryonic stem cell lines, which can be used without destroying new embryos, or with stem cell lines created using newer methods that don’t require embryo destruction. Although the debate over stem cell research was premised on the idea that killing human embryos was an essential part of a promising medical research enterprise, the use of gene editing that inspires the most hope—cures for genetic diseases—does not require embryo research at all.

PAST AND FUTURE POLICY RESPONSES

Those concerned about a future in which parents and doctors control the mood, personality, and intelligence of children through genetic design should urge U.S. government agencies to make it a policy to fund only genetic research with clear medical purposes. No federal money should be spent on research on the genetics of medically irrelevant traits like IQ or athletic ability. Outright legal bans on such research would run afoul of the First Amendment, but there is no reason U.S. government agencies like the National Science Foundation and the National Institutes of Health should set their scientific funding priorities in ways that discourage unnecessary investigations into the genetics of traits that could one day be enhanced. Crafting public policies that will effectively discourage this kind of research will not be easy; much of the funding for such work comes from non-government sources, and the line between medical and non-medical genetic traits can be fuzzy in many cases. As with other
moral norms, maintaining the taboos around genetic research requires more than just laws: scientific institutions need to play a role in guiding the work of individual scientists. Professional associations like the American Society of Human Genetics are already developing policy statements on human gene editing, but they should also articulate policies for how and whether scientists should pursue research that might one day be used by those pursuing an agenda of human enhancement.

Several U.S. policies already in effect address the issues raised by gene-editing experiments using human embryos. Perhaps the most significant is the longstanding Dickey–Wicker Amendment, an appropriations rider that prohibits the federal government from funding research in which human embryos are created or destroyed. This means that research like that done by Mitalipov can’t be funded by the federal government, but it can be conducted using private funds or funds from state governments.

More recently, the U.S. Congress banned the Food and Drug Administration from considering any applications for approval of any uses of gene editing on human embryos. This will probably be enough to prevent any U.S. doctors from using gene editing on embryos in a clinical setting for the time being. This policy, however, does nothing to stop scientists from creating and experimenting with human embryos for research purposes, and for that reason it probably won’t be enough, on its own, to stop gene editing for reproductive purposes in future.