World's first genetically modified human embryo raises ethical concerns

April 27 2015, by Hannah Brown

The genetic modification of humans make many people feel very uncomfortable. Credit: Tatiana Vdb/Manuel/Flickr, CC BY

It all started with a rumour. Then just six weeks ago, a warning rang out in the scientific journal Nature, expressing "grave concerns regarding the ethical and safety implications" of creating the world's first genetically-modified human embryo.

Then last week, a Chinese group from Sun Yat-sen University, reported that they had, in fact, done it: they had created the first genetically-

modified human embryo.

They reported that, in a world first, they had taken "human tripronuclear embryos", and altered mutant DNA that causes the human disease β-thalassemia, which is life-threatening and affects 100,000 people worldwide.

But one person's stern warning is another's delight. The promise of technologies like this – to cure diseases like cystic fibrosis or Huntington's, or even to remove the BRCA mutation, which dramatically increases a woman's risk of dying from breast or ovarian cancer – have been exciting biologists for years.

Cut and paste

So what exactly did the Chinese researchers do? And why has it caused such an uproar?

First, the experiments were performed on human embryos. The researchers collected non-viable embryos from IVF clinics. Then they used this non-viability argument as the ethical justification for performing the work. Scientists know that the embryos were not capable of resulting in a human life, because they were tripronuclear. That means one egg had been fertilised by two sperm, a biological situation we know cannot result a live baby.

Into these embryos, the scientists injected "molecular scissors", known as the CRISPR/Cas9 system, which can target a specific segment of DNA.

In this case, they targeted the HBB gene, which causes β-thalassemia. They then cut out the disease-causing region and replaced it, almost as simply as you may cut and paste in a word-processing document.

But it wasn't quite that clean and simple. The researchers reported "off target effects" and "mosaicism". This means the editing sometimes occurred at the wrong place in the DNA and that it wasn't occurring in all embryos equally. There were many mistakes, which they could not have predicted.

Made to order?

This raises at least two issues. The first is the ethical issue surrounding the use of human embryos for scientific research, and associated concerns around creating designer babies. The second is the fact that this editing went so wrong in so many embryos.

Without total control of the DNA editing process, the outcome for a baby born from a technology like this one is completely unknown.

This unpredictability and uncertainty means the promise of eliminating certain diseases by editing the DNA of embryos is likely to be a very long way off. There is also the issue of testing whether the technology is safe.

The notion of testing the technology on a live human baby is problematic indeed. Should a scientific research ethics committee ever agree to let this research be performed?

Fortunately, in Australia, all research performed on human embryos is tightly regulated by the NHMRC, which prohibits human cloning as well as many other technologies, and enforces strong penalties for non-compliance. This means that, for the foreseeable future, this type of research is very unlikely in Australia.

While the scientific world is divided as to the possibilities for this technology in embryos, including the reality of preventing or curing

disease, there is consensus that this research must proceed with extreme caution.

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