Ethical problems in clinical genetics

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Introduction

The preference of the Czech Medical Chamber MUDr. Milan Kubek wrote that the intelligentsia without morals and without conscience breeds crime. The eternal and insatiable thirst for knowledge is the basic premise of scientific and technical progress, which is driven by the desire to help and serve, but, unfortunately, no less often by the determination to kill and destroy. How many discoveries and inventions, born of the will to do good, have been misused and used for destruction?

Undoubtedly, ethical problems concern all areas of medicine, currently gene therapy in the field of medical genetics is being discussed in particular.

Genetics therapy

Molecular genetics has reached a stage where, in an effort to prevent the development of hereditary diseases in particular, attempts have been made to modify the genome (all genetic information stored in DNA). Gene therapy represents, on the one hand, hope for incurable patients, but on the other, a potential threat to all of humanity.

The first major advance that led to our current successes was the completion of the Human Genome Project in 2003, which dealt with the sequencing of the entire human genome. This in itself brought ethical problems related to the protection of information created in this way.

The first female genome, which was completely sequenced, was still publicly accessible with the consent of the owner, because we only gradually began to realize the fear of misuse of the information contained in the genome, the Charter of Fundamental Rights and Freedoms and the Civil Code and the prevention of discrimination against the patient on the basis of his social, national or ethnic origin and health status. (NCSL, 2011)

There is currently an effort to edit the genome. If this effort is successful, intervention in the genome will lead to the removal of mutations (disorders) by replacing the change in the genome with the original "physiological" state. The first question is whether hitting the genome will miss the intended target and whether our targeting is so precise that it will not find any other target in the genome. The latest research in this area is directed in this direction. The fundamental problem is in which cells the gene replacement would take place.

Gene therapy at the level of somatic cells, i.e. cells other than germ cells (egg, sperm), should be ethically acceptable. It is actually an analogue of organ transplantation, but here at the molecular level. One gene, i.e. one section of DNA, is changed. The change affects only one type of cell and is not passed on to the next generation. The first such attempt was the replacement of a mutated (damaged) gene encoding a non-functional adenosine deaminase in blood cells. Adenosine deminase is an important enzyme which, if it is non-functional, which is precisely caused by a mutation in the gene for this enzyme, then a very severe immune disorder occurs in such affected children. The resulting immune disorder is fatal in children without a bone marrow transplant, because the body cannot deal with any infection.

Genome editing

A completely different type of gene therapy aims to change the genome in reproductive cells (egg, sperm). Once the genome of a sperm or egg, or even an embryo early in development, is altered, the change is permanently embedded in the genome, and if the embryo developed, it would be passed on to the next generation and spread spontaneously through the population.

We still know too little about the human genome to risk its changes being passed down from generation to generation with consequences we don't know about. The problem is not so much that these methods would be used to treat hereditary diseases, but rather that it is now a real possibility to plan and implement genetic improvement. The line between gene therapy and gene enhancement is blurred. While therapeutic use is generally accepted by the professional and lay public as ethically relatively uncontroversial, enhancement is considered controversial to say the least and is often condemned as unacceptable.

Let's imagine that humanity will solve all the problems associated with the technical implementation of gene therapy/enhancement, will be able to edit (change) the genome of a human embryo, so that a person with the desired characteristics and abilities is born. And let's ask ourselves what path such a "modified" humanity can take.

Quite rightly, we can assume that the improvement will not be a cheap matter, and thus only a wealthy group of people will be able to afford it. Parents invest time, energy, but also financial resources in their offspring. So there is no reason why at least some economically strong families should not decide to invest in the genetic improvement of their children. If such an improvement gives the child stronger health, higher performance, resistance, and also a sharper mind, the child will find a much better job in adulthood and achieve higher income at the same time. Genetically enhanced people will thus open up greater possibilities for improving the genome of their own offspring. And at the same time, they will not have inhibitions, because they themselves have already been improved. Thus, the next generation will both inherit the improvements of their parents and, on the other hand, gain additional improvements through the new improvement of the embryo. Genetic improvement will thus accumulate in the population as a kind of capital. The rest of society will be subject to genetic enhancement to a much lesser extent or not at all. On the one hand, it will be financially costly, on the other hand, they may be prevented from doing so by their moral convictions, or they may reject them for religious, ethical or other reasons. However, the gap between enhanced and unenhanced people would grow.

If the differences between people were to grow, the creation of an artificial reproductive barrier is not excluded. If two populations lived side by side, one of which accumulated genetic capital and the other stood outside this process, then the offspring of partners coming from different groups would inherit only half of all the modifications of the improved individual. This means that in subsequent generations they would no longer pass on all their improvements to their offspring and would cause something like a "dissolution" of the accumulated genetic capital in the population.

Nevertheless, I think that sometime in the not-too-distant future, experiments in the field of embryonic genome editing will occur. Above all, it is necessary to prevent these experiments from being carried out under uncontrolled conditions by irresponsible scientists.

I think that the importance of heredity, not only in disease states, is not yet fully appreciated. They say that if someone is hit by a car, heredity has no effect on their injuries. But is it really so? Someone is born smarter and reacts quickly, jumping in front of the car in time, and someone else has slower reactions and is hit by the car. These characteristics are, at least partially, genetically determined. And who wouldn't want bright, smart and strong children?

Properties such as quickness, intelligence, logical thinking, artistic talent, but also probably most genetically determined diseases, are, however, heterogeneous conditions. Therefore, it is very difficult to study them at the molecular level. Even in diseases where the causative mutation in a single gene that leads to the disease has been unequivocally identified, it is not possible to say with certainty whether the disease will manifest itself. An example is mutations in the BRCA genes, which are among the highest risk genes for breast cancer in women. For the descendants of a patient who carries a mutation in the BRCA1 or BRCA2 genes, there is a 50% risk of inheriting the mutation in the gene, however, it is not certain whether they will actually get the disease. Men in particular can be carriers of a mutation in the BRCA gene, but they can live their entire lives without developing cancer. It is considerably more difficult to study diseases that are obviously genetically determined, such as some mental disorders. These diseases are profoundly devastating for both patients and their families and are associated with mutations in several genes. It would certainly be very necessary to eliminate them, for example by gene therapy. Even if it were possible, it must be taken into account that in some patients these diseases are associated with above-average creativity and that gene therapy would on the one hand eliminate the disease, but on the other hand it would perhaps impoverish humanity for example by some discovery, invention or work of art.

Considerations about changes in the human genome are additionally complicated by the fact that genes are subject to Darwinian selection, but this is also supplemented by the influence of the external environment. These cannot be predicted in advance and can depend on chance, the environment, or other influences that we don't even know can have an influence. So we cannot rely on genetic determinism alone.

Gene therapy is not the only controversial topic in medical genetics.

Termination of pregnancy

We also face ethical problems with pregnant women whose fetuses have been diagnosed with a developmental defect during an ultrasound examination. Here we should specify what kind of defect it is. We shouldn't lump a cleft lip and, for example, a complex heart defect in the same bag.

As for the complex heart defect, it is a very severe congenital developmental defect that is often incompatible with the further life of the child, and even if it were operable, it would cost both the parents and the child a lot of effort, because it would completely she certainly didn't solve it with just one operation.

However, a cleft lip is something different. It can represent only a cosmetic/aesthetic problem, which can be solved with the possibilities of today's plastic surgery already a few days after birth. But on the other hand, how can we be sure that a cleft lip is not part of some larger, more complex defect - a syndrome? Try as we might, we are not able to recognize all diseases or syndromic units before the child is born. If we only see a cleft lip in the fetus, but we see nothing else, who will guarantee that the child will not be weak after birth, will not be delayed in development and will be completely fine? No one can guarantee us that.

If any pathology is detected in the fetus on ultrasound, the effort is to examine it, to find out more information. Nowadays, parents also have the option of terminating a pregnancy on the basis of a congenital developmental defect in the fetus. How big the defect should be is not defined in the law.

Tested children

As for predispositions to cancer, the recommendations are clear. In most (but not all) cases, a child cannot be tested before the age of 18. The reason is quite simple. Every person should have the right to decide for themselves, and thus whether they even want to know that they have an increased risk of, for example, breast cancer.

But what about testing children for diseases that are proven in a family member of the child (mother or father), but with manifestations only in adulthood?

An example can be myotonic dystrophy II. type, which is the most common muscle disease occurring in adulthood. Symptoms of the disease usually begin to appear around 30-40 years of age. If we prove the disease, i.e. confirm it genetically in a sick parent, should we test this disease in his children who have no symptoms of the disease? Test children immediately, postpone testing until the child's reproductive age, or test individuals only after they also show symptoms of the disease. Shouldn't children have the right to decide if they want to be tested instead of having their parent decide in childhood? Won't this testing, with a possible positive result, be traumatic for the children, limiting? Won't it cause them problems at school or with their peers? And won't other children view this individual differently?

Conclusion

There are many other ethical questions in the field of medical genetics, and more will surely arise as the field advances. We have been dealing with some of the ethical questions for a long time and we still don't know the right answer to them. All that remains is to act according to your best knowledge and conscience.

Sources

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