THE LATEST ACHIEVEMENTS OF CYBERNETICS IN THE WORLD OF MEDICINE

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Among the humanists of the Renaissance, the opinion about the absolute superiority of the human body was widespread. Educated people of that time considered our bodies to be perfect mechanisms and the best creations of God. However, it is difficult to ignore the numerous defects of humanity, and any living organisms in general. Ever since the imperfection of the flesh disgusted man, thoughts about salvation through something more reliable than nature – through progress - have arisen. Cybernetics became the way to salvation from the diseases of old age and disability. Let's look at the achievements in this science and evaluate whether it lived up to expectations.

Let's start with the mechanical heart that saves people with disease of real heart. Surprisingly, it became possible to establish this technology a hundred years ago. Back in 1937, the dog's heart was replaced with a blood-pumping device. Since then, numerous operations have been performed on humans, although not without complications. The function of the heart is to pump blood and it seems like it is not difficult, but this option is not suitable for everyone. Most people need a machine that will push the blood in pulsations, rather than draw it evenly like a pump. The fact is that with uniform movement of blood, the probability of damage to blood cells and, as a result, blood clot increases. Therefore, mechanisms have been developed that can

simulate the chambers of a real heart with the help of valves, but that's not all. The blood flow needs to be regulated incredibly precisely, and the heart consumes electricity, so a person has to carry the drivers and batteries on him in a backpack. You can guess that the wires pass through the wearer’s body, which is not only inconvenient – he has to take medicines that reduce the activity of the immune system so that it does not act against foreign materials. Many variations of mechanical hearts were invented, but the record was set by the model SYNCARDIA TAH. In 2017, the patient lived with this model for four and a half years. However, this is a record, and therefore mechanical hearts are used so that a person can live until the moment of transplantation of a real "living" heart.

Kidneys are an organ that has been replaced more effectively - it was difficult for people to understand their work and imitate it. This is how dialysis was invented - a procedure during which the pumped blood is freed from urea and pumped back into the body. Such a process is able to provide people with kidney failure the opportunity to live to old age. However, what about no less important organs - sense organs? Of course, humanity is most interested in the restoration and improvement of the most important of them – the eyes. Briefly about their work – light passes through the cornea, with the help of the lens it is focused on the retina, which consists of ten layers of nerve cells. They send a signal to the optic nerve, which delivers it to the brain, and an error can occur at any stage. However, most often a part of the retinal cells is damaged, and therefore it is possible to stimulate the remaining ones. Argus 2 is still the only prosthesis that passed all the tests and was approved for sale. Basically, these are glasses with a camera that transmits a signal to a set of electrodes in the retina. Such a mechanism allows a blind person to see a sixty-pixel image, that is, the outlines of large objects, but it is better than nothing and the technology continues to develop. For example, the Pixium Vision prosthesis, whose chip is placed under the retina and, as of 2017, allows you to see 1,500 pixels. Patients could distinguish small objects with it. In 2020, a curved three-dimensional cornea was created, which allows you to make the image three-dimensional. However, so far this is only a device, that is not clear how to insert into a person. For its work, a

technology of deeper interaction with the brain is required, and such a technology exists.

We can remember some modern prosthetic limbs that are controlled by people, but they work without a connection to the brain. They are controlled by the twitching of the muscles left on the stump. Therefore, the owner of the prosthesis cannot feel mechanical limb as part of himself and it is difficult for him to calculate the pressure. Scientists are also trying to solve this problem by interacting with the brain, so as not to connect to the nerves, which is even more difficult. The only option is to stimulate the nerve with electricity, but this requires tracking each area of the skin on the hand to transmit the exact signal that will convey a feeling of pressure, for example, to the thumb. Plus, you need separate receptors for vibration, temperature, you also have to be careful not to activate the pain signal - you would not want to feel agony at the moment when a cold breeze blew on the robotic hand.

Finally, it's time to talk about neuroimplants. In general, attempts have been made to create cyborgs from animals for a very long time. In 1963, a bull's emotions were successfully controlled - by pressing a button, it could be made to instantly calm down. All thanks to a brain implant. Later, neuroengineer Jose Delgado continued the tests, giving rise to one of the most controversial technological breakthroughs of mankind - the fusion of machine and mind. At that time, lobotomy was used to treat violent patients throughout the civilized world, so Delgado’s inventions were an attempt to prevent such a destructive intervention. From animals, he moved on to people. With the help of brain stimulation, it was possible to cause a person to have fits of anger and instantly calm him down. Of course, the reaction of society to this was negative, but this technology was a colossal breakthrough for people with motor coordination problems.

Completely paralyzed people can also be helped with bionic limbs integrated with neurointerface devices. In other words, cyber-limbs that can be controlled with thoughts. In 2000, Brazilian neuroengineer Miguel Nicolelis demonstrated a monkey that could control a robotic arm with its thoughts. Eight years later, a system was demonstrated in which a monkey also controlled a robot moving on a treadmill. This

allows the technology to be controlled remotely rather than implanted in the body.

And finally, the most discussed invention to date is Neurolink. Back in 2016, Elon Musk announced the launch of a project whose essence is to provide a person with the opportunity to remotely control a computer or smartphone. However, this is only part of the potential of this technology – the main goal is to help people with various diseases, such as Parkinson's, or those who wear mechanical prostheses. The size of the processor, which is attached to a person, should be only sixteen square millimeters, and the electrodes that are implanted in the brain are thinner than a hair. Of course, only a robot can perform such a delicate operation, but fortunately, robots like Da Vinci already exist, and this year a successful operation has been performed on a person without complications.

So, despite the enormous path that cybernetics has to go, it can still impress and is incredibly valuable for humanity.

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