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Robotics in Medicine

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A few decades ago, no one expected that «robots» would find use in medicine. The beginning of their introduction into medicine is the 80s of the last century. Currently, medical robots are used mainly in general surgery, oncology surgery, gynecology, urology. Medical robotics is a young field developing as a result of the cooperation of specialists in the field of medical sciences and engineers. The obvious goal of the designers is to minimize the risks of surgical intervention, limit blood loss, and reduce the number of potential complications. Robots are the most advanced tools of humans. A medical robot is a tool in the surgeon's hand that allows performing surgical operations in hard-to-reach areas of the human body. In most cases, medical robots are telemanipulators that combine the action of a doctor and an effector on the other side. Specialized surgical robots are used to perform surgical procedures at a distance.

The Da Vinci robot surgeon was created to facilitate the work when performing complex surgical operations. Its application can be found in many areas of medicine. The Da Vinci surgical system consists of four parts. The first is a surgical console, which is responsible for control, the second is a robot with three or four arms. In addition to them, we find surgical instruments «EndoWrist» and a 3D vision system [1].

Surgical console can be located at different distances from the patient. Thus it is possible to conduct a teleoperation. The person conducting the procedure sees the image of the

patient's body through a special video detector, which additionally allows you to display the image in 3D. There are also manipulators located at the appropriate height to facilitate the operation.

Surgical robot-consists of three or four arms and only they have direct contact with the patient. The arms are equipped with surgical instruments «EndoWrist», and two of them correspond to the right and left hands of the operator (surgeon), the other is an addition that improves the performance of the robot. The fourth hand is responsible for controlling the camera in the patient's body. Thus, the presence of an assistant who is responsible for controlling the camera is not required in the operating room. The size of the hands is small enough to minimize the incisions of the patient's coverings and reduce the risk of tissue damage.

«EndoWrist Tools» are tools that are designed to simulate hand and wrist movements, they have seven degrees of freedom. These tools make it easier for the operator to clamp or make a seam. Their advantage is easy interchangeability during procedures. In addition, this system eliminates unwanted shaking of the operator's hands.

3D vision system – allows you to view the image of the patient's body in three dimensions, thanks to images on two cameras. These images are well optimized, the appropriate filters remove noise and interference.

Currently, intensive research is also underway to develop nanorobots that facilitate diagnosis, deliver the drug to a specific place of action in the human body and improve procedures and operations. In the future, such a device may be used for controlled therapy in humans.

3D printing technology for the production of biological material finds potential applications in regenerative medicine. This technology is especially useful for complex tissues showing differences in cell types and mechanical properties.

3D printing uses various classes of materials; biological: polymer hydrogels, ceramic materials, composites and cellular aggregates. 3D printing is especially useful for creating anatomical models of organs that are used by doctors to carry out and plan complex procedures [2].

With the help of 3D technology, it is possible to make a drug with complex shapes of various densities and diffusions containing a variety of active and auxiliary substances. The disadvantage of this technique may be, on the contrary, the weak mechanical properties of tablets, since they are usually very porous and are characterized by a weak bond of particles of individual substances [2].

Studies have shown that 3D-printed tablets are characterized by flexibility, which is very difficult to achieve during traditional production. It was also possible to obtain a tablet that combines two mechanisms of drug release by erosion and diffusion. In 3D technology, it is possible not only to print complex forms of the drug with expanded and modified release, but also rapidly disintegrating tablets.

Robotics in medicine has great potential. Wide application of robots in many areas of medicine allows to accurately perform operations with less risk. The development of technologies and the introduction of innovative solutions in the field of medicine is one of the priorities of modern science. Every year there are new solutions that can significantly affect the effectiveness of diagnosis and therapy of many diseases, which significantly affects the increase in life expectancy.

References:

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