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MEDICAL ROBOTICS

АННОТАЦИЯ. Целью данной статьи является рассмотреть различные виды роботов и способы их применения в медицине. Роботы могут улучшить точность хирургии, ускоряя выздоровление и делая ее менее опасной; они также отслеживают жизненно важные признаки и улучшают качество жизни.

КЛЮЧЕВЫЕ СЛОВА: робототехника, роботы, медицина, хирургия.

ABSTRACT. The purpose of this article is to consider the different types of robots and how to use them in medicine. Robots can improve the accuracy of surgery, speeding recovery and making it less dangerous; they also monitor vital signs and improve the quality of life.

KEY WORDS: robotics, robots, medicine, surgery.

How many people would want to go under the knife of a robo-surgeon? It might seem like a solution dreamed up by Aldous Huxley, but it's already a reality. Since 2000, more than two million operations worldwide have been performed by about 3,000 da Vinci surgical robots. While each one fills a decent-sized room, their "hands" are super-small, high-precision instruments. Now researchers are racing to develop the next generation of surgical robots to help to seek and destroy cancers, set bones or even just a hold a camera during an operation.

It might conjure up an image of Star Wars' C-3PO in scrubs, but many of these medical machines are actually closer to the robots used to build your car. "It's not that the robots do any of the surgery themselves," says Tony Belpaeme, professor of cognitive systems and robotics at Plymouth University. "They are instruments for the surgeons to use for keyhole surgery, as they offer greater precision than handheld tools, particularly in hard-to-access parts of the body such as close to the spinal cord, and recovery is then so much faster because the operation is so precise."

Not that a lack of automation is anything to be sniffy about; these machines still use powerful computers to carry out difficult jobs. Their lack of automation is down to the technological challenges of giving a robot the skill and judgment of a surgeon, as well as the lurking fear of legal action and even just the desirable reassurance of having an expert on hand for those awful "what-ifs".

Where the researchers are taking their cue from the seriously sexy technology of driverless cars is, for example, in the development of domestic robots for palliative care, be it helping you make a cup of tea or alerting the doctor if you skip your medication. "I don't see any application for artificial intelligence during surgery at the moment," says Belpaeme. "For a computer to do something intelligent, it has to be able to see what's happening. Now that's OK in a structured environment, but the operating theatre is just a mess to a computer and it will be very hard for it to make sensible decisions. However, I do see a role in the future for more autonomous robots giving surgeons a helping hand as an assistant during operation."

Initially, the vision behind the da Vinci robot was that a surgeon in London could operate in safety on a sick child in Liberia or a wounded soldier in Afghanistan, but financial, technological and communication worries have, for the present, put paid to such dreams. Now the promise of medical robotics lies in facilitating operations that are quicker and more accurate, meaning shorter hospital stays, greater patient turnover, lower chances of patients catching hospital superbugs and an overall saving of money. Robots in the home offer further support, keeping patients eating, moving and medicating.

For surgeons, who are often backing the development of these robots, the benefits of a machine like the da Vinci system are manifold. "The natural instinct of a surgeon is to be hands on the patients, so sitting at a console staring at a screen controlling a robot does take some getting used to," says Pardeep Kumar, consultant urological surgeon at the Royal Marsden, London, who regularly operates using the da Vinci robot. "But it is such an immersive experience that I've been able to carry out more operations, more quickly and successfully than I could have dreamed of. I just

bumped into one of my patients being discharged three to four days after an operation using the robot, instead of the three to four weeks it would have taken in the past."

But it isn't just about high precision. "The physical demands of surgery aren't talked about much," says Kumar. "As a surgeon I have vowed to keep going until I am in my mid to late fifties, but the strain on the neck, shoulders and back make it difficult to keep going for much longer than that. However, operating sitting down using a robot means I could keep going for longer than I had thought."

It isn't just keyhole surgery that can benefit from cutting-edge tech. Sanja Dogramadzi, a reader in robotics in the department of engineering design and mathematics at the University of the West of England, is a pioneer of medical robotic technology for the operating theatre. In collaboration with Professor Roger Atkins, an orthopedic surgeon at University Hospitals Bristol, she designed what is believed to be the first robot-assisted system to tackle the problem of complex joint fractures. For her, the attraction of medical robotics is about solving complex problems that can change lives: "Medical robotics has lots of potential to transform the quality of life of every single one of us. If you can put bones back together, then people can walk again. What's more important than that?" For Dogramadzi, the main technological challenge is achieving accuracy while avoiding what some see as the cumbersome form of systems like the da Vinci. "We are building a modular system that consists of a number of small interlinked robots. And while each component can be accurate down to less than a millimeter or degree, the problem is, how accurate is the whole system when it is working together?"

However, she too believes it could be a while before autonomous systems are admitted to theatre. "Hardware would, for example, need positional sensors and safety stops to prevent accidents," Dogramadzi says. "The software would have to be able to work on many different levels at the same time – what the scalpel was doing, what was going on with the auxiliary staff in the operating theatre – then bring it all together to make a decision. This is a big challenge. By keeping the surgeon in the operating theatre it makes our research easier, cheaper and quicker."

But if physically constructing medical robots is difficult, the real sticking ground is the quagmire of ethics. “Who is responsible if something goes wrong? It is not always going to be one organization. It’s going to be complicated,” says Dogramadzi.

Yet while scalpel-wielding robots might alarm patients, there is evidence that, for some procedures at least, they may be cautiously welcomed. “The initial pilot study in 2013 into patients’ perceptions of using robots in foot fracture surgery was generally positive,” Dogramadzi says. But, as she points out, surgeons were clearly in the picture. “I doubt that the response would have been so positive if the robot was fully autonomous.”

These are issues of huge import, yet to those at the bench it makes progress frustratingly slow. “Obviously you should not be able to go and do whatever you want,” Dogramadzi says, “but there are so many obstacles in the way of actually doing a project like this.”

One that has risen to the fore in the wake of the NSA revelations is that of privacy and security. Indeed, while home-help robots, such as Mobiserv, have a beguilingly innocent face, the data they hold could make them prime targets for hackers. Autonomous surgeons, robotic pills and contraceptive chips take concerns to a whole new level.

And well they might. This year a security audit published by Essentia Health, which runs about 100 hospitals, doctor’s surgeries and pharmacies in Minnesota and neighboring states, helped to reveal to the public how badly protected much of our current healthcare technology is. Critical equipment, such as pumps that distribute antibiotics around the body and defibrillators, were, according to the report, vulnerable to hacking with one of the issues being the poor use of passwords and rare employment of data encryption. It was even possible to change medical records or reboot machines or reboot machines. The firewalls of surgical robots in particular were easy to take down.

Despite such concerns, Dogramadzi believes there will be a rise in robotics in many areas of medicine. “I am working now with a radiographer to see how we can use novel robotic technology to help position people during radiography,” she says.

But it seems that even if questions of security and privacy can be ironed out, some procedures that will always be tackled the analogue way: “Culturally we still like to have a human there to look after you if something goes wrong, like in childbirth. We could go in that direction – but probably shouldn’t.”

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