Tiny robots used in surgical procedures

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Tiny robots that aid surgical procedures and medical checkups currently are the focus of intense research and study. In fact, some of these small-scale devices already are in practical use.

The robots, equipped with arms less than 1 centimeter long, can move around inside the human body and treat affected areas, echoing ideas first set out in science fiction. The small devices are able to repeat subtle movements precisely, making doctors' lives easier. Furthermore, due to the size of the robots, patients need only small incisions to undergo major surgery.

Four domestic facilities have introduced medical robots using systems developed by U.S. companies, such as the da Vinci surgical system.

Under the da Vinci system, an endoscope and a clamp are used in tandem with the tiny robots, which enter the body via small incisions to treat affected areas or assist with bypass surgery. This latter technique is due to be introduced at Tokyo Medical University Hospital, which already has introduced the system for cardiac surgery and urology, according to the hospital.

The complete system weighs a total of nearly 1 ton.

The robots' arms operate similarly to human wrists. Surgeons operate by remote control scalpels and clamps attached to the arms, while viewing the targeted areas on a monitor.

"There's less blood loss as the system allows surgery to be more precise," said Kunihiko Yoshioka, associate professor in urology at the university, based in Shinjuku Ward, Tokyo.

Domestically, the development of such robots is still at the research level. Many of the experimental mechanisms are unique, apparently reflecting the character of particular researchers.

Makoto Nokata, associate professor of the College of Science and Engineering at Ritsumeikan University in Kusatsu, Shiga Prefecture, is attempting to design a fingertip-sized robot that would move inside the body to conduct checkups and surgeries. Unlike capsule endoscopes, which enter via the mouth and exit the body when a patient has a bowel movement, Nokata envisions a robot that would remain inside the body for an extended period.

The robot would be maneuvered inside a patient via magnets surrounding the body - a technique similar to that used in computerized tomography. The robot would move based on changes in the magnets' poles. In an experiment conducted two years ago, a robot inserted into a hare's groin moved via the abdominal cavity to the liver. Nokata said he was inspired by the 1966 U.S. science fiction movie "Fantastic Voyage." In the movie, a submarine carrying a medical team is made small enough to enter the human body and move around inside.

"With the robot inside (the body), patients don't need incisions when further surgery or tissue examination become necessary," Nokata said.

Naoki Suzuki, director of Jikei University School of Medicine's Institute for High-Dimensional Medical Imaging in Komae, western Tokyo, has developed an endoscopic robot that moves like a snake. Surgeons operate clamps about 6 millimeters long while monitoring images on a screen - as with the da Vinci robot - but as the robot enters via the

mouth, there is no need for incisions.

When the robot reaches the stomach, it makes a small hole in the stomach wall with an electronic scalpel and moves into the abdominal cavity to conduct surgery on various organs. In an experiment using a pig, the technique successfully removed gastric mucosa and made an incision in the liver.

In Thailand last year, a robot - remotely controlled from Kyushu - successfully removed lymph nodes from the abdomen of a dead human body in a joint venture between Kyushu University Hospital and Chulalongkorn University in Thailand.

According to a March report on the midterm goals of the Robotics Society of Japan and other entities, these kinds of robots, which presently are merely considered a kind of surgical tool, will become capable of automatically conducting entire medical operations - from diagnosis to treatment - sometime between 2025 and 2050.

The government has recognized the da Vinci system as an advanced medical service, which means fees for prostate surgery are partly covered by medical insurance.

In addition, such robots have been adopted as one type of advanced medical equipment in the special structural reform zones for advanced medical treatment development. Project proposals from these zones are made a high priority in the government's approval process.

Professor Masakatsu Fujie of Waseda University's School of Creative Science and Engineering is jointly developing a cardiac surgery robot in conjunction with Gifu University. The team aims to put the product into practical use within five years.