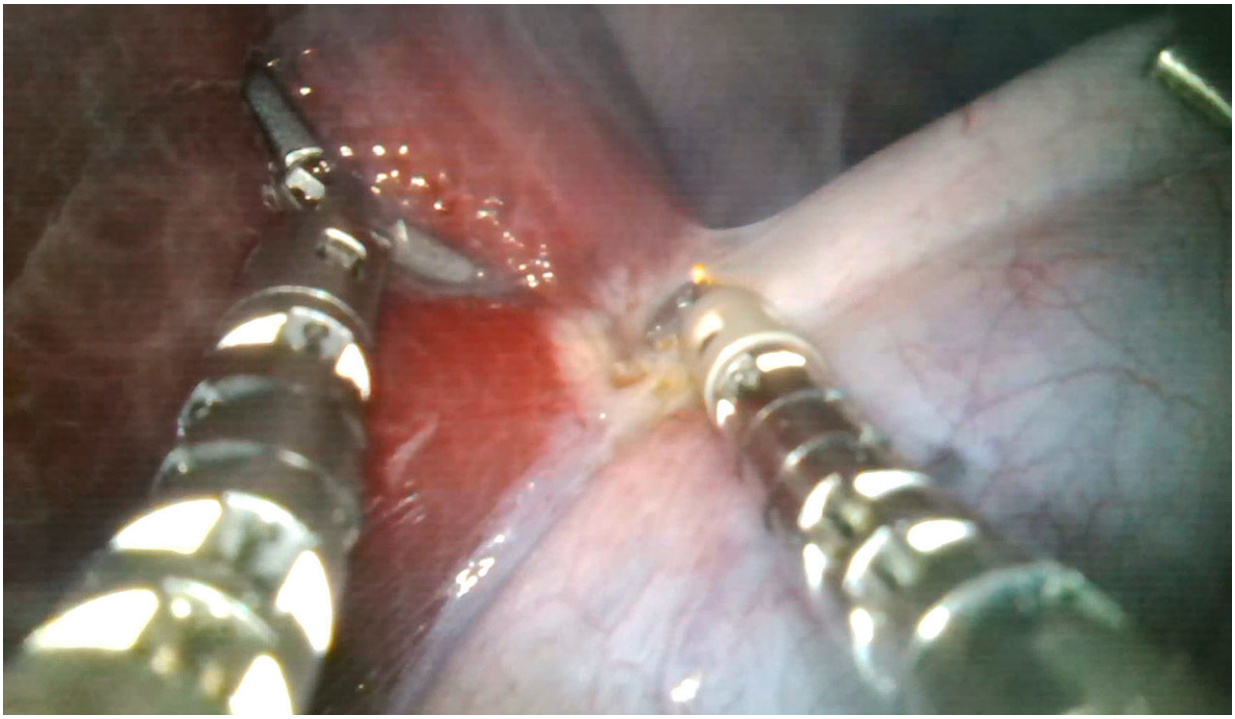
'K-Flex' makes a splash as a flexible endoscopic surgical robot

August 20 2018



Robot arms perform an incision during an ex-vivo test on a porcine gallbladder. Credit: KAIST

K-FLEX, a flexible endoscopic surgical robot developed by the KAIST Future Medical Robotics Research Center, opens a new chapter for minimally invasive robot-assisted surgery with its precision control of 3.7 mm diameter robotic arms. The two arms, placed at the end of

flexible endoscopes, offer precision control with robust mini-joint design technologies.

The research team under Professor Dong-Soo Kwon recently tested the device in-vivo, conducting a complicated endoscopic procedure dissecting a porcine gallbladder in collaboration with Professor Dae-Kyung Son of the National Cancer Center. The arms successfully manipulated the tissue safely.

During the test, K-FLEX, inserted through an incision in the navel, snaked through the narrow passages of the inner organs. At the desired spot, one of the robot arms pushed aside and held up the nearby tissue to secure proper vision and space for the procedure. Meanwhile, a cautery needle mounted at the tip of the other arm removed lesion tissue on the gallbladder. The tiny camera installed at the front of the robot arms relayed the internal conditions. The full procedure was monitored from the master console.

The two arms are located on the 4.2 mm internal channels of a 17 mm diameter endoscope. The arms can be deployable forward and backward and are extendable up to 7 cm for performing procedures.

K-FLEX is made of domestically produced components, except for the endoscopic module. It will expand new medical robotics research while offering novel therapeutic capabilities for endoscopes.

The team conducts a procedure using K-FLEX, flexible endoscopic surgical robot. Credit: KAIST

Flexible endoscopes are promising for surgical applications because they can treat areas that are difficult to reach, such as the posterior side of an organ. Current rigid-type laparoscopic tools cannot lesions in similarly inaccessible areas. Seamlessly integrating effective actuation into millimeter-scale deployable mechanisms fits well with minimally invasive surgical procedures. This flexible endoscopic surgery robot, only half the size of current laparoscopic surgical robots, is deployable into natural orifices such as the mouth, anus and vagina without requiring external incisions. Laparoscopic devices and robots require at least three to four external incisions for insertion. Using only internal incisions reduces the possibility of complications arising from excessive bleeding and bacterial infections.

The researchers sought to develop robotic arms for flexible endoscopes

with integrated grabbing force, flexibility, and multiple degrees of freedom for clinical environments. The team focused on smaller but smarter devices. Dr. Min-Ho Hwang, a principal researcher of K-FLEX, said that developing tiny robots that can generate the necessary force without compromising safety was the challenge. They created a robust joint technology that can exert a relatively greater force even at the millimeter scale.

Professor Kwon said, "K-FLEX is the first flexible endoscopic surgery robot in Korea. We confirmed the clinical adaptation through ex vivo tests and will see complete commercialization in two to three years." The team believes K-FLEX will be very effective for surgery on incipient cancer cells in the stomach, colon, and thyroid.

Provided by The Korea Advanced Institute of Science and Technology (KAIST)