Low-cost and easy-to-use laparoscopic equipment

Unmet Need

Minimally invasive surgery is the standard of care in high-income countries for a wide range of procedures including appendectomies, hernia and knee surgeries, with 3.5 million laparoscopic procedures done every year in the U.S. alone. Laparoscopic procedures are also gaining popularity in veterinary medicine in the U.S., for a wide range of applications, following historically higher uptake in Europe for spaying dogs. The North American veterinary laparoscopy market is growing and projected to top $10B in 2023, almost half of the global market. However, laparoscopic equipment can cost up to $200,000, require a stable electric power source, and use compressed carbon dioxide. These requirements create barriers for use in low- and middle-income countries (LMICs) and for veterinary practitioners, so open surgery are more common, leading to higher rates of complications and prolonged recovery times. There exists a need for low-cost and easy-to-use laparoscopic equipment with performance comparable to the standard of care laparoscope.

Technology

Duke inventors have developed very low-cost and easy-to-use laparoscopic equipment with performance comparable to the standard of care laparoscope. This laparoscope comprises a small CMOS detector surrounded by a custom ring of LEDs, housed in thin, biocompatible stainless-steel tubing with an ergonomic plastic casing. The LEDs and camera are powered through simple USB connection. The group has also developed a separate compatible device. The gasless retractor includes a biocompatible stainless-steel rod bent into a semicircle which is slotted through a small incision, rotated, and then pulled upward to create a workable volume for surgery. Prototypes of this system have performed as well as standard of care laparoscopic equipment in proof-of-concept laboratory experiments – they will be tested in a porcine model and undergo clinical validation with surgeon partners in Uganda.

Advantages

- Very low-cost system, about $500 compared to almost $200,000 for a traditional laparoscope setup
• Provides standard of care-level camera resolution, image quality, illumination, white balance, and video lag.
• Low power consumption through USB allows for decoupling from inconsistent local electrical grids and delicate fiber optic cables
• Eliminates need for expensive and energy-intensive compressed carbon dioxide gas for retraction
• Highly portable
• Plug-and-play software designed specifically for this laparoscope, can be easily connected to a laptop or tablet
• Live video streaming capability allows for remote surgery observation and partnership
• Simple construction with consumer-level parts minimizes training and maintenance requirements
• Completely waterproof, able to be sterilized by submersion for reuse

Publications

• An Accessible Laparoscope for Surgery in Low- and Middle-Income Countries (Annals of Biomedical Engineering, 2021)
• KeyLoop: Mechanical Retraction of the Abdominal Wall for Gasless Laparoscopy (Surgical Innovation, 2021)