April 21, 2015

# Groundbreaking NIR Fluorescent Polymer and NIR Fluorescence Intraoperative Navigation Technology Developed

**Tokyo, Japan**－DIC Corporation, Kochi Medical School (part of Kochi University) and NIPPON COVIDIEN LTD. today announced the development of a near-infrared (NIR) fluorescent polymer and intraoperative navigation technology employing instruments made from this polymer.

Kochi Medical School's achievements to date in this area include the development of a medical imaging device that facilitates the simultaneous capturing of color and NIR images and an artery visualization device that transmits NIR, both of which achieved as part of a program to promote research aimed at creating new industries, the result of a project sponsored by Creation of New Business and Industry through Kochi Prefectural Industry-Academia-Government Collaboration Research Promotion Operations. At present, the only NIR fluorescent dye used as a contrast agent in clinical applications is indocyanine green (ICG). However, rapid thermal degradation and solubility in water have to date precluded the incorporation of ICG into polymeric hosts, thus preventing the formation of NIR fluorescent polymers.

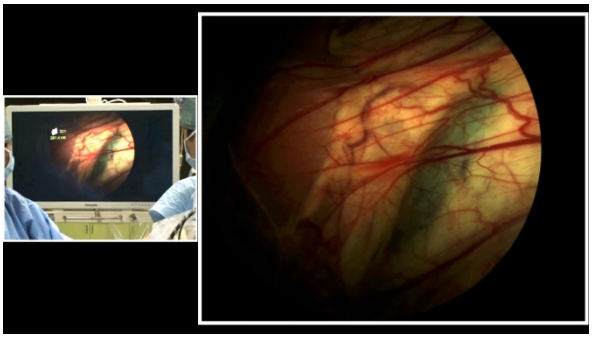
DIC and Kochi Medical School have succeeded in developing a new NIR fluorescent dye that can be incorporated into polymer, the outcome of joint R&D aimed at realizing an NIR fluorescent dye with high thermal resistance, suitability for hot melt mixing with polymer, and a fluorescence intensity more than 20 times that of ICG, which yielded a number of promising candidates. Kochi Medical School subsequently partnered with NIPPON COVIDIEN to select the optimum dye candidate and polymer material and develop an NIR fluorescent polymer with a fluorescence intensity more than 30 times that of ICG, from which they then fabricated a prototype ureteral catheter. The efficacy of the prototype catheter was tested on pigs using surgical simulation in collaboration with a research group at the International University of Health and Welfare led by Professor Masashi Yoshida.

Medical imaging used to guide surgical procedures for, and to diagnose medical conditions of, the gastrointestinal tract, ureters and blood vessels, among others, involves irradiation with X-rays to create static images of internal body structures, with contrast agents introduced to enhance the visibility thereof.

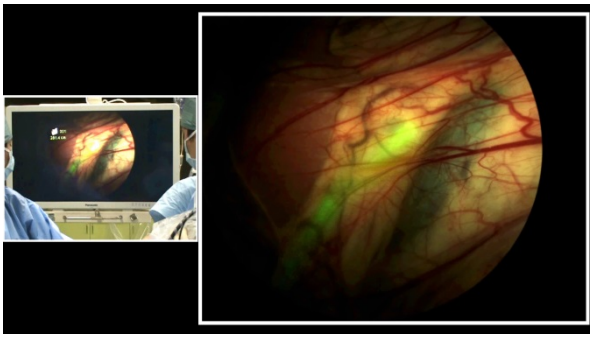
However, because ionizing radiation is used, prolonged exposure is hazardous. This concern is eliminated with the new catheter, which can be guided into place by surgeons in real-time, without the use of radiation, increasing both precision and safety. In surgery to remove a cancerous mass from the uterus, for example, pinpointing the position of the ureters behind layers of fatty tissue can be a challenge. Moreover, in the event of mass adherence to tissue surrounding the ureters there is a danger that removal may lead to accidental injury. The insertion of an NIR fluorescence ureteral catheter enables the surgeon to keep track of the ureters on a monitor during surgery, thereby significantly reducing risk to the patient.

The new NIR fluorescence polymer also offers promise for use in navigation of surgery to resect cancerous lesions from the digestive tract mucosa (the innermost layer, which surrounds the lumen), in which it is clipped to the digestive tract to facilitate visualization of the affected portion from the serosa (the outermost layer, that is, the layer visible to the surgeon). Among a diverse range of other potential applications are surgical instruments and fibers for medical gauze, the benefits of which include a reduced incidence of surgical items being mistakenly left inside patient's bodies.

Use of ureteral catheter to pinpoint the position of the ureters

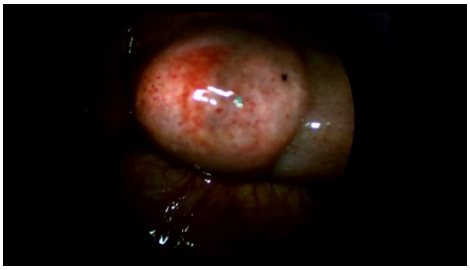


NIR excitation off

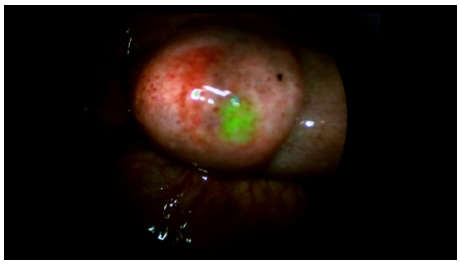


NIR excitation on

Use of digestive tract clip to visualize affected area (large intestine)



NIR excitation off



NIR excitation on

* NIR fluorescence rendered in lime green