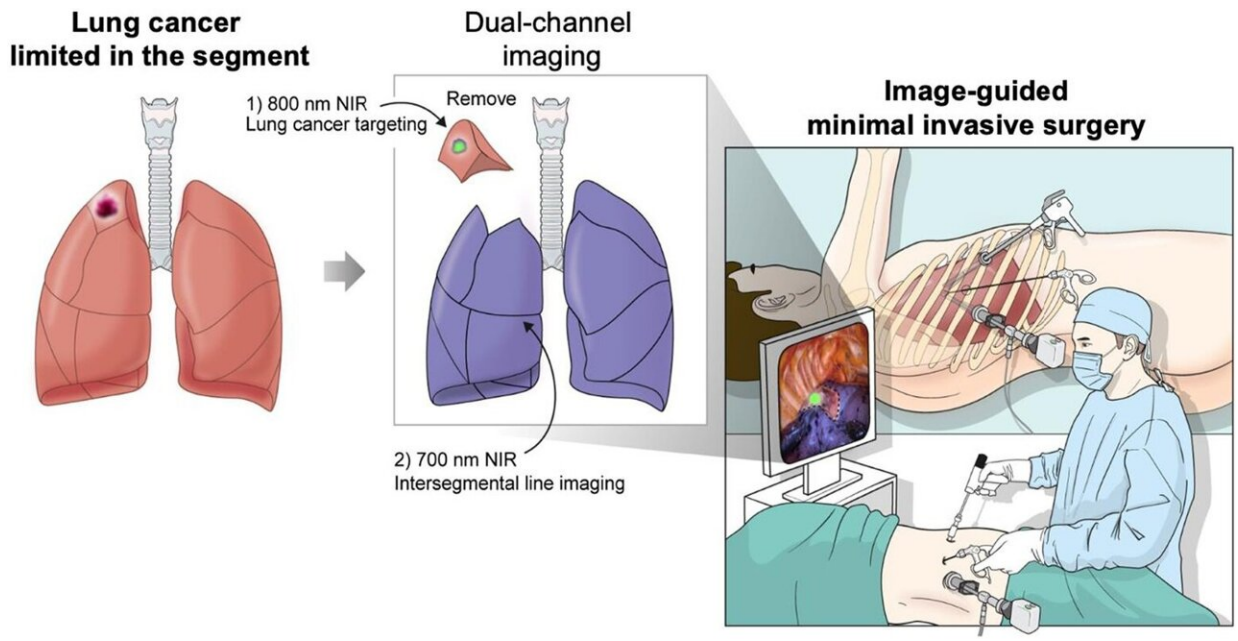
Dual-channel fluorescence imaging for precise and safe pulmonary segmentectomy

July 2 2024



Process of minimal invasive surgery. Credit: Korea University College of Medicine

The research team of Prof. Hyun Koo Kim of the Department of Thoracic and Cardiovascular Surgery, Korea University's Guro Hospital, has developed "precise and safe pulmonary segmentectomy enabled by visualizing cancer margins with dual-channel near-infrared fluorescence" for the first time via joint research with the research team of Prof. Hak Soo Choi of Harvard Medical School.

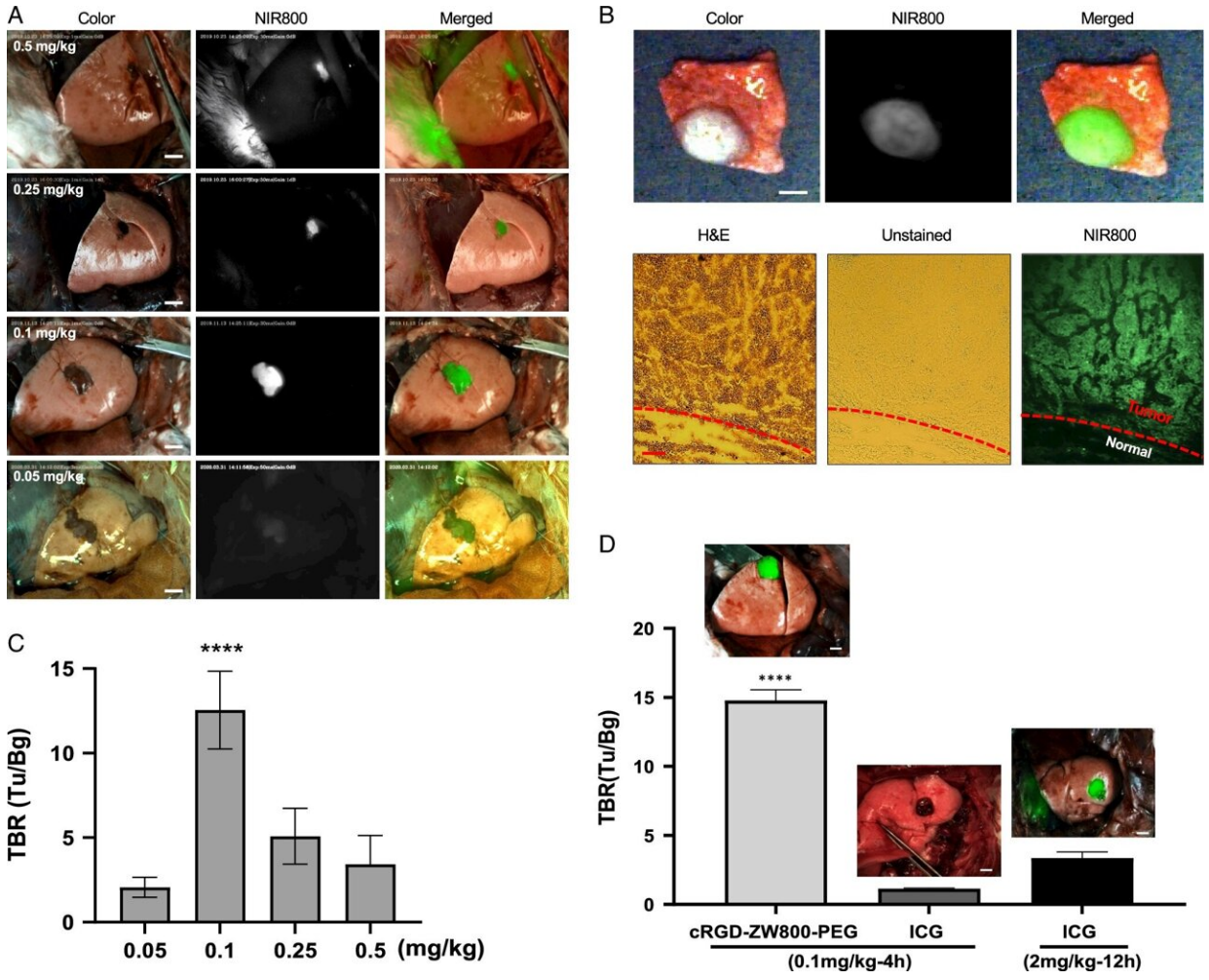
The study was published in the *International Journal of Surgery*.

Recently, lung cancer surgery has developed a way to improve the patient's quality of life by removing cancerous tissue while preserving normal tissue as much as possible. According to large-scale clinical research conducted by the US and Japan, in the case of early-stage lung cancer measuring less than 2cm, a limited segmentectomy shows a 5-year survival rate, which is a similar result to lobectomy, while preserving more normal lung tissue. Although segmentectomy requires precise division between intersegmental lines of lung cancer and normal lung area, research on this has been insufficient.

Therefore, the research teams developed dual-channel near-infrared fluorescence (cRGD-ZW800-PEG with 800 nm wavelengths, ZW700-1C with 700 nm wavelengths) and a technique of simultaneously exploring lung tumors and intersegmental lines using dual-channel fluorescence imaging during surgery. The feasibility of the dual-channel fluorescence imaging technique was evaluated in medium and large-sized animal models with lung cancer.

As a result, lung cancer and intersegmental lines were accurately explored simultaneously for up to 30 minutes through injection of cancer-targeting fluorescence (cRGD-ZW800-PEG) and contrast agents confirming blood flow distribution around cancer (ZW700-1C and ZW800-PEG) in the preclinical study (medium and large-sized animal models with lung cancer). This demonstrated the fluorescence agent's high effectiveness during surgery.

In addition, dual-channel fluorescence is physically and chemically stable. Remarkably, this has excellent in vivo safety, as more than 85% of it is excreted through the kidneys within 4 hours after intravenous injection, which was confirmed by preclinical studies.



Tumor targeting by cRGD-ZW800-PEG in rabbits with lung tumors. A, B. Dose optimization of cRGD-ZW800-PEG (green) for lung tumor targeting in rabbits. C. Top, representative *ex vivo* lung images of color, 800 nm NIR fluorescence (NIR800), and merged. Bottom, H&E, bright-field, and NIR800 fluorescence images of tumor tissue. The red dotted line indicates tumor margin with the tumor tissue being above the red dotted line and showing NIR 800 nm fluorescence signal. D. Comparison of lung tumor targetability between cRGD-ZW800-PEG and ICG. ****P

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