Photoacoustic endoscopy could improve Crohn's disease treatment

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A newly developed endoscope could give doctors a better view of intestinal changes caused by Crohn's disease. This additional information would help improve treatment of the painful and debilitating form of inflammatory bowel disease, which currently affects hundreds of thousands of U.S. adults.

Researchers from the University of Michigan describe the new device in The Optical Society (OSA) journal *Biomedical Optics Express*. The endoscope is used for photoacoustic imaging, a relatively new biomedical imaging method that uses light to produce sound waves in tissue that can be captured with ultrasound imaging.

"This new imaging technology could help more accurately plan therapy for each Crohn's disease patient," said Guan Xu, leader of the research team. "This would allow more targeted treatment and help minimize any adverse effects that might result from treatment."

Making treatment decisions

In Crohn's disease, both inflammation and fibrosis cause the development of strictures—areas of narrowing—in the intestines. Although strictures caused by inflammation can be treated with drugs, the ones caused by fibrosis must be removed surgically.

"Currently, there is no imaging modality that can be used in the intestine to distinguish inflammation from fibrosis," said Xu. "The difficulty in accurately assessing the presence and development of ?brosis in the strictures adds a great deal of complexity to Crohn's disease management decisions."

In the new study, the researchers developed a capsule-shaped photoacoustic imaging endoscope to examine whether this imaging technique could be used to characterize inflammation and fibrosis in intestinal strictures. The capsule-shaped probe was 7 millimeters in diameter and 19 millimeters long.

They designed the endoscope to deliver near infrared light at 1310 nanometers because this wavelength is absorbed by collagen protein, which is characteristic of fibrosis. The light absorption causes the protein to expand slightly, leading to a mechanical vibration that can be captured using ultrasound imaging. To generate a strong signal, the researchers constructed the endoscope to maximize delivery of 1310-nanometer light.

Distinguishing inflammation and fibrosis

The researchers tested their new endoscope in rabbit models with intestinal narrowing caused by either inflammation only or a mix of fibrosis and inflammation. The experiments showed the endoscopic photoacoustic imaging approach could quantitatively differentiate inflammatory from fibrotic intestinal strictures. Another study in rabbits demonstrated that the endoscope could also quantify the development of fibrosis over time.

"The method we demonstrated is minimally invasive and can directly assess fibrosis in the intestinal stricture, which has not been demonstrated by conventional medical imaging modalities," said Xu.

The researchers are now working to make the endoscope small enough to pass through the instrument channel of a colonoscope, a flexible fiber-optic instrument used to examine the large intestine. This could provide a surgeon with diagnostic information immediately before treatment without the need for additional procedures.

More information: Hao Lei et al, Characterizing intestinal strictures of Crohn's disease in vivo by endoscopic photoacoustic imaging, *Biomedical*

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