Experimental AI method boosts doctors' ability to diagnose cancers and precancers of the esophagus

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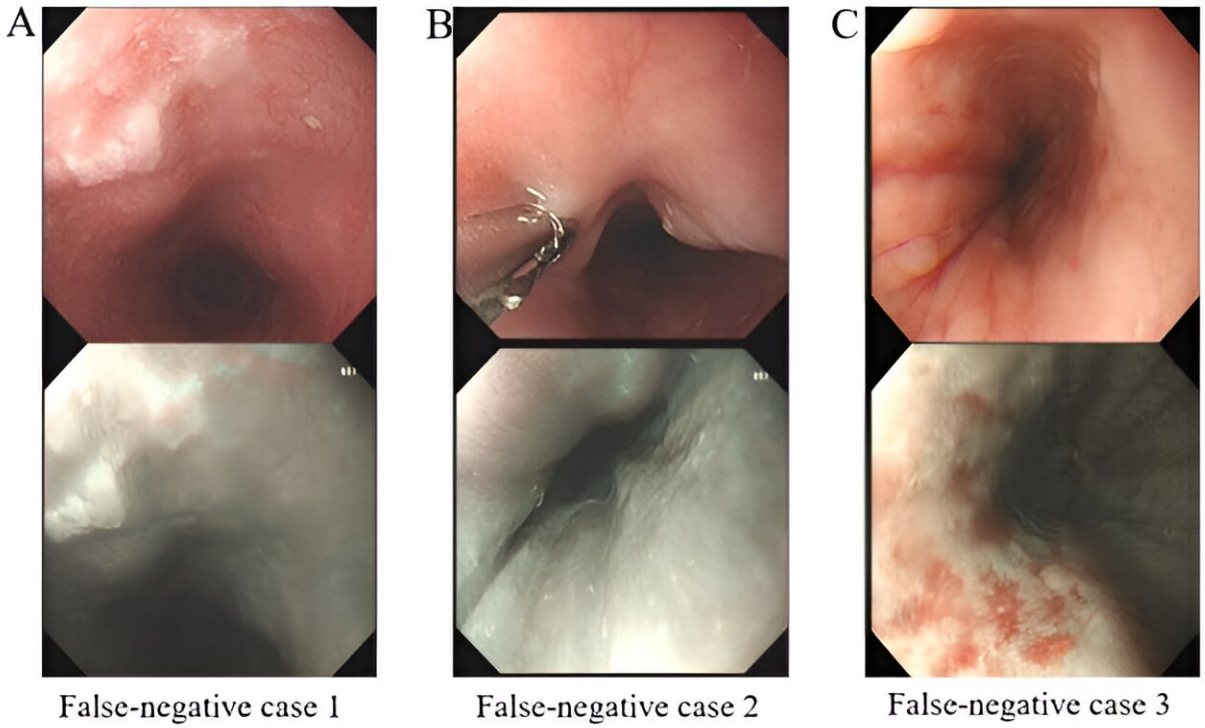

Endoscopic photographs of lesions in three false-negative patients. Credit: *Science Translational Medicine* (2024). DOI: 10.1126/scitranslmed.adk5395

Artificial intelligence is being used in a wide variety of applications in medicine, and now scientists have developed an AI system that can boost

detection rates for cancerous and precancerous lesions of the esophagus, which are sometimes difficult for doctors to find.

The experimental system, developed in China, aims to bring new technology to bear on a significant cause of cancer morbidity and mortality, especially in Asia. While rates of esophageal cancer and Barrett's esophagus, a precancerous condition, have remained stable in the United States, incidence in China has soared and ranks as the highest in the world. Cases in China are followed by those in India, which also reports elevated rates of the malignancy.

Because cancerous and precancerous lesions of the esophagus can be difficult to detect, they pose obstacles to prompt treatment. The new deep-learning system is designed to boost physicians' ability to improve the survival rates of affected patients by identifying high-risk cancers of the esophagus in an early, treatable stage.

In an article published in *Science Translational Medicine*, a team of doctors and scientists from major research centers in China say they have developed and tested a deep-learning algorithm that substantially boosts the detection of high-risk malignant lesions in the esophagus.

So far the team has tested the AI system only on patients in China, but they emphasized that their algorithm has the potential to save lives globally by aiding the early detection of high-risk esophageal lesions during routine diagnostic endoscopies.

"Endoscopy is the primary modality for detecting asymptomatic esophageal squamous cell carcinoma and precancerous lesions," according to Dr. Shao-Wei Li, lead author of the new study, and a researcher in the department of gastroenterology at Taizhou Hospital, an affiliate of Wenzhou Medical University in China.

"Improving the detection rate remains challenging. We developed a system based on deep convolutional neural networks for detecting esophageal cancer and precancerous lesions."

Also known as DCNN, for deep convolutional neural network, the algorithm identifies disease-specific patterns. A deep convolutional neural network is designed to pinpoint patterns in 3D. When used as a diagnostic tool, it theoretically can provide doctors with a more accurate method of identifying high-risk lesions in patients undergoing screening. The tool also can spot lesions that might otherwise escape detection when observed via endoscopy using the human eye alone.

Li's interdisciplinary team, from throughout China, designed and built the deep-learning AI system, which was named ENDOANGEL-ELD. It uses datasets from more than 190,000 esophageal images gathered from several clinics in China. After developing the deep-learning system, the team at Taizhou Hospital gave it a test run in a clinical trial involving patients undergoing diagnosis for potentially high-risk esophageal cancers.

Li and colleagues tested the artificial intelligence system in the diagnosis of 1,556 patients from a group of 3,117 at Taizhou Hospital in Zhejiang, an eastern coastal province in the People's Republic of China. The remaining 1,561 patients served as a control group.

Overall, the deep learning system doubled the detection rate of high-risk lesions compared with the control group whose diagnoses were conducted by conventional endoscopy. The ENDOANGEL-ELD method additionally demonstrated a high degree of cancer recognition based on the 190,000 different patterns of the disease fed into the AI system.

"The primary endpoint was the high-risk esophageal lesion detection

rate," Li asserted. "In the intention-to-treat population, the high-risk esophageal lesion detection rate was significantly higher in the experimental group than in the control group," Li added, underscoring that more cancers and precancerous lesions were spotted in the experimental group because of the AI tool.

The 3,117 patients in the study were all over the age of 50, according to data in *Science Translational Medicine*. A second research effort using the deep-learning method is planned that will focus on younger patients.

Improving the method of diagnosing esophageal cancer is especially important in China, where regional hotspots of the disease mark some of the globe's highest rates of the malignancy, according to the World Health Organization.

Smoking and alcohol consumption have been linked to elevated rates of esophageal cancer and Barrett's esophagus, regardless of where the patient lives in the world. China, however, is the world's leading producer and consumer of tobacco products. WHO estimates that there are more than 300 million smokers in China, about one-third of the world's total number of people who indulge in the habit.

The WHO further estimates that 1 of every 3 cigarettes smoked in the world are smoked in China. More than half of adult men in the country are smokers. Esophageal cancer is more common among men than women in the country. Although women in China are far less likely to smoke, they are probably subject to the adverse health effects of secondary smoke.

Esophageal cancer is often asymptomatic, and doctors have long relied on endoscopies to detect tumors and precancerous lesions. Five-year survival rates are good—more than 90%—when the tumor is treated during an early, asymptomatic stage. Benefits from treatment decline

sharply once symptoms emerge, hence the urgency to find a more precise method of detection.

The experimental deep-learning method of screening, according to Li and colleagues, enables timelier diagnoses and more effective treatment of early-stage esophageal cancer. The malignancy is the eleventh-most common cancer worldwide, but the seventh most common cancer globally among men, according to data from the World Cancer Research Fund International, which has headquarters in London.

"The proposed system thus improved the high-risk esophageal lesion detection rate during endoscopy, and was safe," Li concluded. "Deep learning assistance may enhance early diagnosis and treatment of esophageal cancer and may become a useful tool for esophageal cancer screening."

More information: Shao-wei Li et al, Deep learning assists detection of esophageal cancer and precursor lesions in a prospective, randomized controlled study, *Science Translational Medicine* (2024). DOI: 10.1126/scitranslmed.adk5395

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