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Case Report

An artificial intelligence-based system assisted the endoscopist to detect early gastric cancer: a case report

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Abstract:
Background: The mucosal changes of early gastric cancers (EGC) are slight and difficult to be recognized, leading to a high miss rate. Artificial intelligence (AI) systems have the potential to improve the detection rate of EGC. Here, we reported a case of EGC discovered by an endoscopist with the assistance of an AI system.

Case presentation: A 67-year-old male patient came to our hospital for Esophagogastroduodenoscopy (EGD) due to a routine physical examination. He had previously been healthy but was treated for a Helicobacter pylori infection two years ago. In the process of EGD, the AI system flagged a tiny mucosal lesion that was far away and was not detected by the endoscopist, and this lesion attracted the endoscopist's additional attention. After the close observation of the lesion, the AI system immediately gave a red prompt box, suggesting that the endoscopist further observe it. Under magnifying endoscopy with narrow-band imaging (ME-NBI), the mucosal glands and blood vessels of the lesion were found to be irregular, and this patient was diagnosed with suspicious gastric carcinoma by AI. Biopsy pathology showed that it was high-grade intraepithelial neoplasia, and after endoscopic mucosal dissection (ESD), post-ESD histology confirmed that the lesion was a highly differentiated adenocarcinoma confined to the mucosa, with a lesion range of 1.1 cm × 1.0 cm. The patient was discharged from the hospital without any postoperative complications.

Conclusion: AI has been widely applied in the field of gastrointestinal endoscopy and has the potential to help improve the detection rate of early gastrointestinal cancers. We reported a case of early gastric cancer discovered by the endoscopist with the assistance of AI.

Keywords: Early gastric cancer, Artificial intelligence, Gastrointestinal endoscopy

Introduction

Gastric cancer (GC) is the fifth most common cancer in the world and one of the leading causes of cancer-related mortality. In 2020, approximately 1.1 million people were diagnosed with GC, and 770,000 people died from it [1]. Gastric cancer has a high mortality rate since most patients are diagnosed at an advanced stage. In most parts of the world, the five-year survival rate of advanced GC patients is only 20% while the five-year survival rate of early gastric cancer (EGC) patients can be as high as 90%

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[2]. Therefore, the timely detection and subsequent treatment of EGC can significantly reduce the mortality rate and save the patients's life.

Esophagogastroduodenoscopy (EGD) is the main strategy to detect gastric mucosal lesions. White light endoscopy (WLE) is the main tool for early cancer screening. However, EGC mostly has no obvious symptoms, and the endoscopic features of mucosal lesions are subtle and often overlooked. In addition, the quality of endoscopy depends on the experience of the endoscopist, but the experience levels of endoscopists vary, so there is a high rate of the missed diagnosis of EGC [3]. How to improve the detection rate of gastric cancer is a serious problem we are facing.

In recent years, artificial intelligence (AI) technology has become a research hotspot in the medical field, showing great potential in gastrointestinal endoscopy. ENDOANGEL is an AI system that can monitor blind spots, detect EGCs in EGD in real-time and make preliminary predictions about the depth of invasion and differentiation status of EGC. This system has been reported in detail in previous studies[4-7]. This report presented a case of EGC discovered by an AI system named ENDOANGEL.

Case presentation

A 67-year-old Chinese male patient came to Wenzhou Central Hospital for EGD due to routine physical examination. He had previously been healthy but was treated for a Helicobacter pylori infection two years ago. He said that he had no obvious physical discomfort and the physical examination did not reveal any abnormal findings. But his father died of gastric cancer. In the process of EGD, the AI system flagged a tiny mucosal lesion that was far away and was not detected by the endoscopist, which attracted the endoscopist's additional attention. The close observation of the lesion demonstrated that it was located in the posterior wall of the gastric antrum near the pylorus, with slight uplift and slight yellow and granular surface, which was classified as type 0-IIa according to the Paris classification (Figure 1). ENDOANGEL then gave a red prompt box and suggested the endoscopist for further observation under magnifying endoscopy with narrow-band imaging (ME-NBI). When the lesion was carefully observed under ME-NBI, it was found that there was a clear demarcation line (DL) around the lesion with irregular glands, and microvessels varied in diameter and size, which were irregular in shape (Figure 2), and ENDOANGEL diagnosed it as gastric neoplasm. Therefore, it was suspected to be a highly differentiated adenocarcinoma, and biopsy histopathology confirmed that it was high-grade intraepithelial neoplasia. Computed tomography (CT) showed no lymph node metastasis. Three days later, the endoscopist successfully removed the tumor completely using endoscopic submucosal dissection (ESD) without any residue (Figure 3).

The result of histopathological diagnosis was well-differentiated adenocarcinoma, the depth of invasion was limited to the mucosal layer, and the lesion range was 1.1 cm ×1.0 cm (Figure 4). Both the lateral and base margins were negative, and the surrounding gastric mucosa showed severe atrophic gastritis and intestinal metaplasia. Immunohistochemical findings were as follows: MUC5AC (+), MUC6 (+), CD10 (+), MSH2 (+), MSH6 (+) and MUC2 (-). The patient was discharged from the hospital without any postoperative complications. At the last few follow-ups, the patient recovered well, was in stable condition without any discomfort, and did not require any adjuvant systemic chemotherapy.

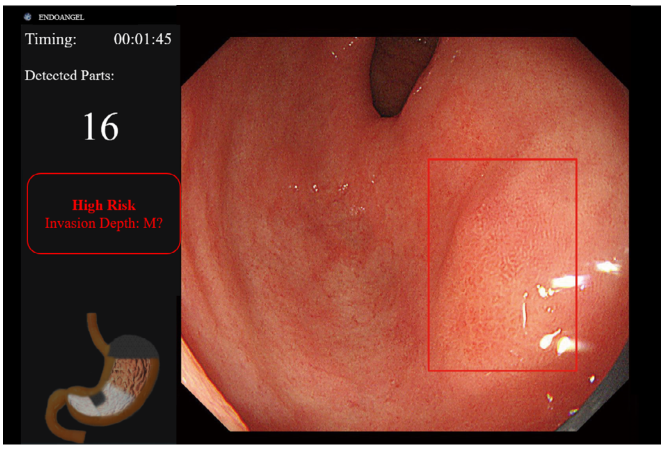

Figure 1. ENDOANGEL red frame suggests lesions. The lesions were slightly uplifted and the surface was slightly yellow and granular.

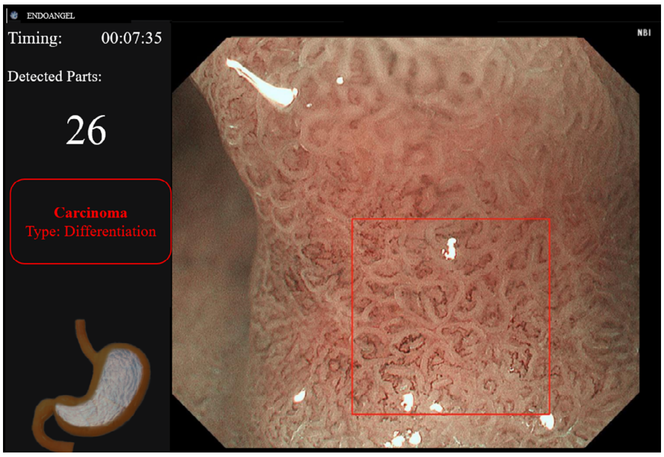

Figure 2. The lesions were observed under narrow-band imaging (ME-NBI). There was a clear demarcation line (DL) around the lesion with irregular glands, and microvessels varied in diameter and size and were irregular in shape. And ENDOANGEL diagnosed the lesion as differentiated carcinoma.

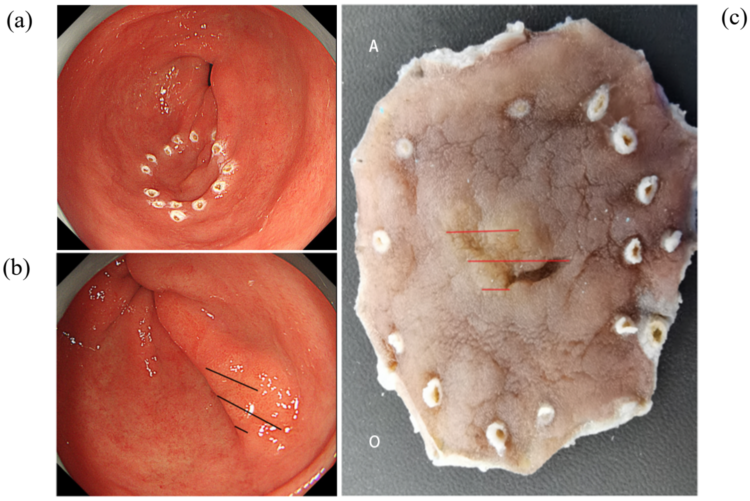

Figure 3. The lesions were resected by ESD. The assessment of lesion boundary before ESD (a) and the correspondence between tissue specimens resected by ESD (b) and mucosal lesions under white light endoscopy (c). O: oral-lateral, A: anal-lateral.

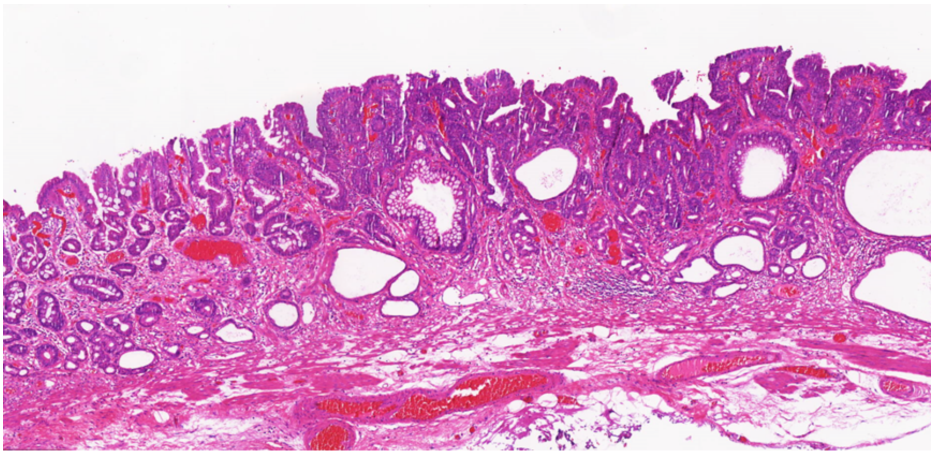

Figure 4. Histopathological findings. The infiltration depth of adenocarcinoma cells did not penetrate the mucosal layer.

Discussion and conclusions

The mucosal changes in EGC are subtle and easily confused with benign gastric mucosal lesions such as gastritis, which endoscopists tend to ignore. Once gastric early cancer is missed, it will pose a serious threat to the patient's health. We reported a case of EGC detected by an AI-assisted endoscopist in a real clinical setting. Under white light endoscopy, the lesion showed a slight uplift and a yellowish and granular appearance on the surface, which differed significantly from typical early cancer features and was easily missed.

In recent years, AI has shown great potential in gastrointestinal endoscopy, which is expected to improve the current problem of the low detection rate of gastric early cancer. Hirasawa et al. are the first to report a deep learning model that can automatically detect gastric cancer in still images, with an overall sensitivity of 92.2% and a positive predictive value of 30.6% [8]. Tang et al. developed an early gastric cancer detection system with an accuracy of 85.1% to 91.2% in a retrospective analysis [9]. With the assisstance of AI system, the performances of trainee endoscopists for detecting EGC are comparable to those of expert endoscopists. Wu et al. developed an AI system called ENDOANGEL [4], which can detect early gastric cancer with an accuracy of 92.5% under white light endoscopy. Subsequently, they pretested the performance of the AI system in detecting EGC in a multicenter randomized controlled trial [10]. Furthermore, they evaluated the effect of ENDOANGEL in clinical practice in a randomized controlled clinical trial [11]. The results showed that using AI system can reduce the gastric neoplasm miss rate. Subsequently, ENDOANGEL achieves a sensitivity of 91.8% and a specificity of 92.4% on diagnosing neoplasms in another prospective clinical trial [12]. These studies suggest that AI has great potential for diagnosing EGC.

Magnifying narrow-band imaging improves the detection rate of EGC, and experienced endoscopists can successfully make a preliminary diagnosis of the nature of differentiation and depth of infiltration of lesions. However, WLE is still the main way to screen for EGC. Studies have shown that the sensitivity for diagnosing EGC in WLE is only 48% [13], depending on the skill and experience levels of endoscopists. Wu et al. hold a nationwide human-machine competition to compare the performances of an AI system and endoscopists using 100 EGD videos[14]. The sensitivity rates of the system for detecting neoplasms and diagnosing EGCs are 87.81% and 100%, respectively, while those of endoscopists are only 83.51% and 87.13%, respectively. These results indicate that AI systems have great potential to improve the detection rate of EGC, especially for inexperienced primary endoscopists or endoscopists in primary hospitals in remote areas. Similarly, for experienced endoscopists, an AI system can act as an additional reminder to reduce the missed diagnosis rate of EGC.

The gastric early cancer reported in this paper is an example of the application of artificial intelligence in a real clinical environment. In the future, we expect AI to make more breakthroughs in gastrointestinal endoscopy.

Ethics and consent

Informed consent was obtained from the patient for the publication of this report.

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Author contributions

Lin J. designed the study and conducted the literature review. Tao X. wrote the first draft of the report, which was further edited by all authors. All authors read and approved the final manuscript.

Disclosure

There are no financial conflicts of interest to disclose.

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