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RESEARCH ARTICLE

Diagnostic Yield and Safety of Advanced Endoscopic Technologies in a Retrospective Cohort of 14,000 Gastrointestinal Procedures at a Tertiary Center

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ABSTRACT

Aim: Technological advancements in gastrointestinal (GI) endoscopy have substantially improved the diagnostic and therapeutic management of GI disorders. High-definition (HD) imaging, narrow-band imaging (NBI), and artificial intelligence (AI)-assisted systems represent transformative innovations aimed at increasing lesion detection and reducing human error.To evaluate the clinical impact of advanced endoscopic technologies, including HD endoscopy, NBI, and AI-assisted detection systems, on polyp detection rates and procedural safety in a high-volume, real-world setting.

Method: This retrospective single-center study included 14,000 patients who underwent endoscopic procedures between January 2018 and December 2022. The primary outcome was the adenoma detection rate (ADR) across different imaging modalities. Secondary outcomes included lesion characteristics and complication rates. Data were analyzed using SPSS version 25.0, with significance set at p<0.05.

Results: Across 8,000 colonoscopies, the ADR was 18.4% for standard HD endoscopy (n=4,000), 27.2% for NBI (n=2,000), and 33.4% for AI-assisted systems (n=4,000). Recognition of small (≤5 mm) and flat lesions (p<0.05) was substantially improved with AI-assisted detection. Complication rates remained low (1%) and comparable across modalities, with no increase in adverse events associated with advanced technologies.

Conclusion: Polyp detection is substantially enhanced with NBI and AI-assisted endoscopy without compromising safety, offering promising adjuncts to standard endoscopic practice. The integration of such innovations may reduce interval cancer risk and support more consistent quality in GI diagnostics.

Keywords: Advanced imaging modalities, artificial intelligence, diagnostic accuracy, endoscopy, gastroenterology, pathology

Introduction

Gastrointestinal (GI) endoscopy has evolved into a critical tool for both the diagnosis and management of a wide spectrum of GI disorders, ranging from benign conditions such as polyps to more severe pathologies, including early-stage malignancies.[1,2] Over the past two decades, remarkable advances in endoscopic imaging technologies have transformed the quality and precision of visual assessment. Historically, fiber-optic systems provided limited resolution and suboptimal clarity, often hindering accurate lesion detection.[3] The advent of high-definition (HD) video endoscopes has dramatically improved image clarity and detail, allowing endoscopists to identify subtle mucosal abnormalities with greater confidence and reduce the rate of missed lesions.[4] For example, the improved visualization offered by HD endoscopes contributes to earlier detection of potentially pre-malignant or malignant lesions, a critical factor that can substantially influence patient outcomes and long-term prognosis.[5,6]

Despite the progress facilitated by HD endoscopes, conventional endoscopy still faces certain inherent limitations. Anatomical complexities, including sharp angulations, folds, and areas of poor distension, can obscure the endoscopist's field of view and potentially lead to undetected lesions.[7] In addition,

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the quality of bowel preparation remains a pivotal factor; inadequate preparation may reduce visibility, thus hampering polyp recognition.[8] Operator-dependent variability also plays an important role; less experienced endoscopists may have lower adenoma detection rates (ADRs), potentially leading to interval cancers and less effective screening programs.[9] Against this backdrop, the introduction of novel endoscopic adjuncts seeks to overcome these limitations. Narrow-band imaging (NBI), for example, enhances mucosal surface and vascular pattern delineation by using specific light wavelengths that increase contrast between normal and abnormal tissue.[10,11] This technique has been shown to improve lesion characterization, aiding endoscopists in distinguishing neoplastic from non-neoplastic lesions more accurately.[12]

Similarly, advanced dye-based techniques, such as chromoendoscopy, can be employed to better highlight subtle mucosal irregularities, particularly in conditions such as inflammatory bowel disease (IBD) where early dysplasia detection is paramount.[13,14] However, perhaps the most transformative development in recent years has been the integration of artificial intelligence (AI) into the endoscopic workflow. AI-assisted polyp detection systems utilize deep learning algorithms and computer vision to provide real-time lesion alerts, thereby acting as a "second observer" that can help reduce the incidence of human error and lapses in attention caused by fatigue.[15,16] Emerging data suggest that these systems can substantially increase ADRs by identifying lesions that might otherwise go unnoticed, potentially narrowing the gap in performance between experienced and novice endoscopists.[17,18]

This study aimed to evaluate the impact of such innovative endoscopic technologies on diagnostic yield and clinical outcomes in a large cohort of 14,000 patients who underwent endoscopic procedures at a single center. Specifically, we assess the performance of standard HD endoscopy, NBI, and AI-assisted detection systems in polyp identification and characterize the associated complications. By analyzing these modalities in a high-volume, real-world setting, we sought to provide robust evidence for the clinical utility of these advanced techniques. Through this evaluation, we hope to determine whether these technological adjuncts can indeed bridge current diagnostic gaps, improve early lesion detection, and ultimately contribute to better patient care and GI health outcomes.

Materials and Methods

This retrospective study was conducted at a single tertiary care center, including 14,000 patients who underwent endoscopic procedures between January 2018 and December 2022. All patients were between 18 and 85 years of age, with a gender distribution of 7,400 men (52.9%) and 6,600 women (47.1%). Of the total procedures, 8,000 were colonoscopies, 5,000 were gastroscopies, and 1,000 were other types of endoscopic interventions, such as endoscopic retrograde cholangiopancreatography and endoscopic ultrasound (Table 1).

The baseline technology for all patients was HD endoscopy. Across the colonoscopies, NBI was employed in 2,000 cases to enhance mucosal detail and vascular patterns in suspicious areas. In 4,000 colonoscopies, an AI-assisted polyp detection system was integrated to identify potential lesions in real-time. In addition, chromoendoscopy with dye application was performed in 500 patients with IBD to improve the visualization and delineation of mucosal changes.

This study was approved by the Ethics Committee of University of Health Sciences Türkiye, Kanuni Sultan Süleyman Training and Research Hospital, with approval number: 2024.l0.235, dated: 01.11.2024. All procedures were conducted in accordance with the principles outlined in the Declaration of Helsinki. Informed consent was obtained from all participants prior to their inclusion in the study, and patient anonymity and confidentiality were strictly maintained.

Exclusion Criteria

Patients were excluded if they (1) had incomplete demographic or endoscopic records; (2) demonstrated poor bowel preparation, defined as a Boston Bowel Preparation score <6; (3) had a history of colorectal surgery that altered colonic anatomy; (4) were known to have colorectal cancer diagnosed before the index procedure; or (5) underwent emergent endoscopy for active bleeding or perforation. After applying these criteria (n=412 exclusions), 14,000 procedures remained for analysis.

AI System Description

The AI platform used was an FDA- and CE-cleared computer-aided detection (CADe) solution (GI-Sense™, version 3.2; MedVision Technologies, Boston, MA, USA). It employs a

Table 1. Distribution of the 14,000 endoscopic procedures

Procedure type	Number of procedures (n)	Percentage (%)
Colonoscopies	8,000	57.1
Gastroscopies	5,000	35.7
Other endoscopic interventions	1,000	7.1
Total	**14,000**	**100.0**

convolutional neural network architecture trained on more than 1.2 million annotated colonoscopy frames. Real-time inference is achieved with <30 ms latency, and alerts are displayed as bounding boxes on the primary endoscopy monitor. Quarterly federated-learning updates are pushed to the system to maintain performance across diverse image sets.

Statistical Analysis

Relevant patient data, including demographics, clinical characteristics, endoscopic findings, lesion morphology, and subsequent treatment interventions, were extracted from electronic medical records. The primary outcome was the rate of polyp detection under different imaging technologies, specifically comparing standard HD endoscopy, NBI, and AI-assisted systems. All statistical analyses were conducted using SPSS version 25.0 (IBM Corp., Armonk, NY, USA), and a p-value of <0.05 was considered indicative of statistical significance.

Results

In total, 14,000 patients underwent endoscopic procedures during the study period. The overall number of detected polyps varied according to the imaging modality and technology used (Figure 1). Standard endoscopy procedures, conducted on 4,000 patients, resulted in the detection of 735 polyps, yielding a detection rate of approximately 18.4%. The application of NBI in 2,000 procedures identified 543 polyps, corresponding to a detection rate of around 27.15%. In comparison, the integration of an AI-assisted polyp detection system in 4,000 procedures led to the identification of 1,337 polyps, reflecting a notably higher detection rate of nearly 33.4% (Table 2).

These findings indicate that both NBI and AI-assisted techniques improved the detection of polyps compared to standard endoscopy (Figure 2). The substantial increase achieved with the AI-assisted system, in particular, underscores the potential of advanced image analysis algorithms to enhance endoscopic visualization, especially for challenging lesions. Not only did the AI-assisted technology outperform conventional methods in overall polyp detection but it also showed a marked advantage in identifying smaller (≤5 mm) and flatter lesions that are often more difficult to visualize using traditional methods. Statistical analysis confirmed that the difference in detection rates between AI-assisted and standard endoscopy was significant ($p<0.05$), reinforcing the clinical relevance of these innovative approaches.

Complications associated with the procedures were infrequent and did not differ markedly between the various technologies. The overall complication rate remained at around 1%, with a small number of severe events, including perforation in 5 patients and bleeding in 20 patients (Table 3). Notably, NBI and AI-assisted endoscopies demonstrated complication profiles comparable to or even more favorable than standard endoscopy. These results suggest that employing advanced imaging technologies not only improves diagnostic yield but also maintains a similar safety profile, providing reassurance regarding the implementation of such innovations in routine clinical practice.

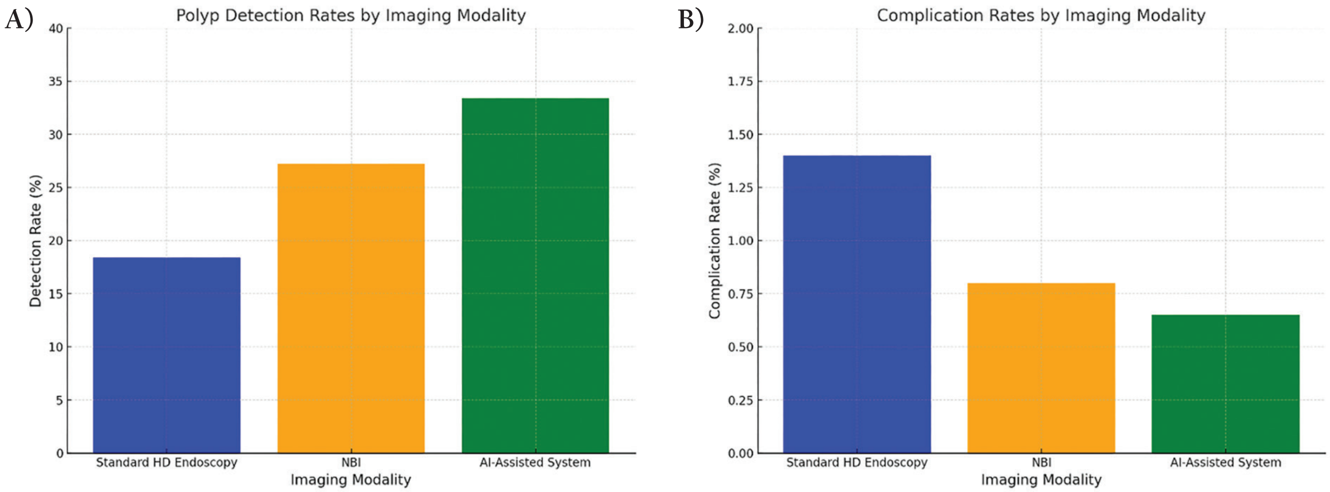

Figure 1. Polyp detection rates by imaging modality (left graph), complication rates by imaging modality (right graph). A) This bar graph illustrates the polyp detection rates (%) for three imaging modalities: standard high-definition (HD) endoscopy, narrow-band imaging (NBI), and artificial intelligence (AI)-assisted systems. AI-assisted systems demonstrate the highest detection rate at 33.4%, followed by NBI at 27.2%, and standard HD endoscopy at 18.4%. The graph highlights the superior performance of advanced technologies, particularly AI, in identifying polyps. B) This bar graph displays the complication rates (%) associated with each imaging modality. AI-assisted systems have the lowest complication rate (0.65%), followed by NBI (0.8%) and standard HD endoscopy (1.4%). The graph shows that advanced imaging technologies not only improve diagnostic performance but also maintain or even reduce complication rates, ensuring patient safety

Table 2. Polyp detection according to different imaging modalities in the colonoscopy subgroup

Imaging modality	Number of colonoscopies (n)	Total polyps detected (n)	Detection rate (%)	≤5 mm polyps (n, %)	Flat lesions (n, %)
Standard HD endoscopy	2,000	368	18.4	55 (15.0)	50 (13.6)
Narrow-band imaging (NBI)	2,000	543	27.2	150 (27.6)	140 (25.8)
AI-assisted polyp detection system	4,000	1,337	33.4	480 (35.9)	420 (31.4)
Total	**8,000**	**2,248**	**28.1***	-	-

*28.1% (average detection rate), HD: High-definition, AI: Artificial intelligence

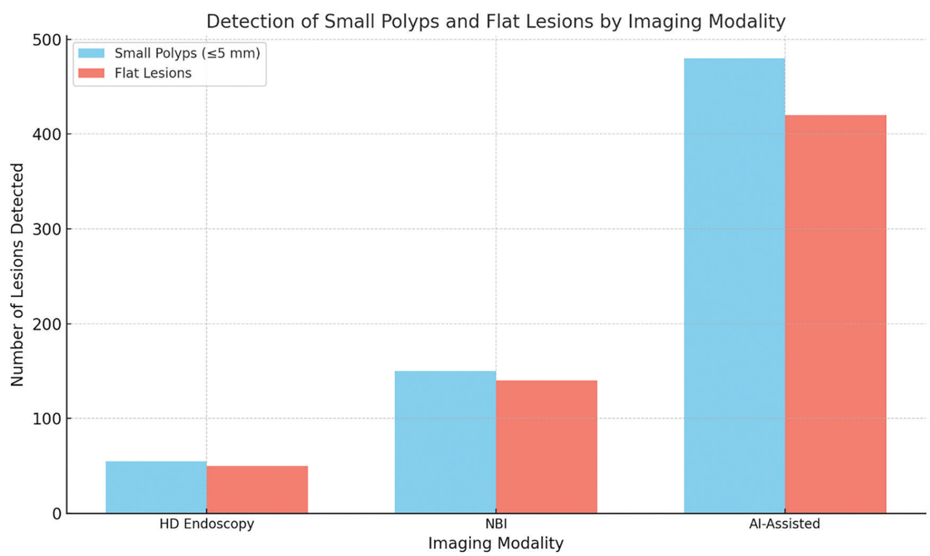

Figure 2. Detection of small polyps and flat lesions by imaging modality. The above grouped bar chart illustrates the detection performance for small polyps (≤5 mm) and flat lesions across three imaging modalities: high-definition (HD) endoscopy, narrow-band imaging (NBI), and artificial intelligence (AI)-assisted systems. Blue bars represent the number of small polyps detected. Red bars represent the detection of flat lesions

Table 3. Complication profile by imaging modality in colonoscopies

Imaging modality	Number of colonoscopies (n)	Perforation (n)	Bleeding (n)	Other minor complications (n)	Total complications (n)	Complication rate (%)
Standard HD endoscopy	2,000	3	10	15	28	1.4
Narrow-band imaging (NBI)	2,000	1	5	10	16	0.8
AI-assisted polyp detection system	4,000	1	5	20	26	0.65
Total	**8,000**	**5**	**20**	**45**	**70**	**0.88**

HD: High-definition, AI: Artificial intelligence

Discussion

Following the promising results achieved with AI-assisted endoscopic systems, subsequent studies have validated the role of CADe and computer-aided diagnosis tools in enhancing lesion characterization and improving overall endoscopic efficacy.[19,20] Recent meta-analyses indicate that the implementation of AI-driven technologies consistently increases ADRs, reduces miss rates, and supports endoscopists in distinguishing hyperplastic from adenomatous polyps more reliably.[21] Notably, the advantage of AI extends across varying levels of endoscopist experience, potentially narrowing the performance gap between expert and novice practitioners, thereby fostering more standardized care.[22]

In our single-center study involving 14,000 endoscopic procedures, we observed a comparable trend: AI-assisted detection not only outperformed standard HD endoscopy in overall polyp detection but also demonstrated a particular advantage in identifying smaller (≤5 mm) and flatter lesions. Such findings align with the broader literature, suggesting that advanced image processing algorithms hold the potential to detect challenging lesions that might otherwise be missed.[21,22]

In addition to polyp detection, emerging literature highlights the potential utility of AI in risk stratification and procedural efficiency. For example, novel machine learning algorithms have been tested to predict polyp histopathology and guide real-time decision-making, allowing for targeted resection and potentially obviating the need for indiscriminate biopsies.[23,24] Furthermore, AI-integrated platforms are being explored to optimize procedural parameters, such as withdrawal times, bowel preparation assessment, and the identification of blind spots within the colon, thereby ensuring a more systematic evaluation of the mucosa.[25,26] Some systems even integrate advanced imaging modalities, including magnifying endoscopy and endocytoscopy, to provide *in vivo* “virtual biopsies”, accelerating the diagnostic process and reducing patient anxiety related to pending pathology results.[27]

Recent randomized controlled trials have reinforced the notion that AI-assisted platforms can sustain high ADRs over time and are not merely transient enhancements confined to research settings.[28] Longitudinal follow-up studies suggest that sustained integration of AI technologies can also influence downstream clinical outcomes, such as reducing interval colorectal cancer rates and improving adherence to screening guidelines.[29] As computational capabilities grow and machine learning models are trained on larger, more diverse datasets, the specificity and sensitivity of AI-assisted detection are expected to continue improving, ultimately translating into better prevention strategies and patient prognoses.[30]

However, the widespread adoption of AI in endoscopy is not without its challenges. Practical considerations, such as the cost of acquisition, the need for seamless integration with existing endoscopy systems, and requirements for stable internet connectivity and data security, must be addressed.[31] Training endoscopists and support staff to effectively use AI-based tools is another important step, ensuring that technology supplements, rather than supersedes, clinical judgment and expertise.[32] Ethical and medicolegal questions also arise with increasing automation, particularly with respect to responsibility for missed lesions and false positives. As AI assumes a more prominent role in guiding diagnostic decisions, it will be essential for professional societies and regulatory bodies to establish guidelines and best practices that uphold patient safety and maintain high standards of care.[33]

Our findings demonstrated that although AI-assisted endoscopy substantially improved polyp detection rates, including in populations such as patients with IBD, where chromoendoscopy is often considered the reference standard, it did so without increasing the complication rate. These observations bolster the body of evidence supporting AI as a safe adjunct to conventional methods. Nevertheless, larger, multicenter studies are needed to validate our single-center experience, especially to confirm whether these advantages hold across different operator skill levels and patient demographics.

Looking ahead, research is moving toward multimodal AI systems that integrate endoscopic imaging with other data sources, including genetic profiles, serum biomarkers, and patient history, to offer a more holistic risk assessment and individualized screening strategy.[34] These integrative approaches may ultimately shape a new paradigm of precision medicine in gastroenterology, where AI-driven insights guide not only lesion detection and characterization but also tailored surveillance intervals, therapeutic interventions, and patient counseling.[35]

Despite the encouraging results from our large cohort, this study also has some limitations. First, it was a single-center retrospective analysis, which could limit the generalizability of the findings. Second, operator experience may have played a role in the outcomes, particularly in the AI-assisted group. Finally, long-term follow-up data on interval cancers were not included in our analysis. Future prospective multicenter trials are warranted to address these gaps and further assess the long-term impact of AI-driven technologies on colorectal cancer prevention and overall patient outcomes.

Conclusion

In summary, this study adds to the growing body of evidence that advanced imaging modalities, especially AI-assisted systems, can markedly improve polyp detection rates. As gastroenterologists continue to seek strategies to reduce colorectal cancer incidence and mortality, these technologies offer a promising approach to refining diagnostic accuracy, minimizing missed lesions, and moving toward a more personalized, efficient, and precise endoscopic practice.

Ethics

Ethics Committee Approval: This study was approved by the Ethics Committee of University of Health Sciences Türkiye, Kanuni Sultan Süleyman Training and Research Hospital (approval number: 2024.l0.235, dated: 01.11.2024).

Informed Consent: Informed consent was obtained from all participants prior to their inclusion in the study, and patient anonymity and confidentiality were strictly maintained.

Footnotes

Authorship Contributions

Surgical and Medical Practices: A.H., Concept: A.H., A.C., Design: A.H., A.C., Data Collection or Processing: A.C., Analysis or Interpretation: A.H., Literature Search: A.H., Writing: A.H., A.C.

Conflict of Interest: No conflict of interest was declared by the authors.

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REFERENCES

1. Corley DA, Jensen CD, Marks AR, Zhao WK, Lee JK, Doubeni CA, Zauber AG, de Boer J, Fireman BH, Schottinger JE, Quinn VP, Ghai NR, Levin TR, Quesenberry CP. Adenoma detection rate and risk of colorectal cancer and death. N Engl J Med. 2014;370:1298-1306.
2. Shaukat A, Kahi CJ, Burke CA, Rabeneck L, Sauer BG, Rex DK. ACG Clinical Guidelines: colorectal cancer screening 2021. Am J Gastroenterol. 2021;116:458-479.
3. Tang Y, Anandasabapathy S, Richards-Kortum R. Advances in optical gastrointestinal endoscopy: a technical review. Mol Oncol. 2021;15:2580-2599.
4. Buchner AM, Shahid MW, Heckman MG, McNeil RB, Cleveland P, Gill KR, Schore A, Ghabril M, Raimondo M, Gross SA, Wallace MB. High-definition colonoscopy detects colorectal polyps at a higher rate than standard white-light colonoscopy. Clin Gastroenterol Hepatol. 2010;8:364-370.
5. Rex DK, Bond JH, Winawer S, Levin TR, Burt RW, Johnson DA, Kirk LM, Litlin S, Lieberman DA, Waye JD, Church J, Marshall JB, Riddell RH; U.S. Multi-Society Task Force on Colorectal Cancer. Quality in the technical performance of colonoscopy: recommendations of the U.S. Multi-society task force on colorectal cancer. Am J Gastroenterol. 2002;97:1296-1308.
6. Calderwood AH, Jacobson BC. Colonoscopy quality: metrics and implementation. Gastroenterol Clin North Am. 2013;42:599-618.
7. East JE, Saunders BP, Jass JR. Sporadic and syndromic hyperplastic polyps and serrated adenomas of the colon. Gastroenterol Clin North Am. 2008;37:25–46.
8. Hassan C, Bretthauer M, Kaminski MF, Polkowski M, Rembacken B, Saunders B, Benamouzig R, Holme O, Green S, Kuiper T, Marmo R, Omar M, Petruzziello L, Spada C, Zullo A, Dumonceau JM; European Society of Gastrointestinal Endoscopy. Bowel preparation for colonoscopy: ESGE guideline. Endoscopy. 2013;45:142-150.
9. Coe SG, Crook JE, Diehl NN, Wallace MB. An endoscopic quality improvement program improves detection of colorectal adenomas. Am J Gastroenterol. 2013;108:219-226.
10. East JE, Vleugels JL, Roelandt P, Bhandari P, Bisschops R, Dekker E, Hassan C, Horgan G, Kiesslich R, Longcroft-Wheaton G, Wilson A, Dumonceau JM. Advanced endoscopic imaging: ESGE technology review. Endoscopy. 2016;48:1029-1045.
11. Pasha SF, Leighton JA, Das A, Harrison ME, Gurudu SR, Ramirez FC, Fleischer DE, Sharma VK. Narrow-band imaging vs white-light colonoscopy: meta-analysis. Am J Gastroenterol. 2012;107:363-370.
12. Sinonquel P, Vermeire S, Maes F, Bisschops R. Advanced imaging in GI endoscopy: current state of the art. GE Port J Gastroenterol. 2022;30:175-191.
13. El-Dallal M, Chen Y, Lin Q, Rakowsky S, Sattler L, Foromera J, Grossberg L, Cheifetz AS, Feuerstein JD. Virtual vs dye-spray chromoendoscopy in IBD: meta-analysis. Inflamm Bowel Dis. 2020;26:1319-1329.
14. Feakins RM. Inflammatory bowel disease biopsies: updated BSG reporting guidelines. J Clin Pathol. 2013;66:1005-1026.
15. Wang P, Liu X, Berzin TM, Glissen Brown JR, Liu P, Zhou C, Zhang D, Laine L, Cohen J, Komanduri S, Gan T, Li L, Liu J, Xiong F, Wang H, Zhang Y, Repici A, Wallace MB. Effect of a deep-learning computer-aided detection system on adenoma detection during colonoscopy (CADe-DB trial): a double-blind randomised study. Lancet Gastroenterol Hepatol. 2020;5:343-351.
16. Mori Y, Kudo SE, Misawa M, Saito Y, Ikematsu H, Hotta K, Ohtsuka K, Urushibara F, Kataoka S, Ogawa Y, Maeda Y, Takeda K, Nakamura H, Ichimasa K, Kudo T, Hayashi T, Wakamura K, Ishida F, Inoue H, Itoh H, Oda M, Mori K. Real-time use of artificial intelligence in identification of diminutive polyps during colonoscopy: a prospective study. Ann Intern Med. 2018;169:357-366.
17. Byrne MF, Chapados N, Soudan F, Oertel C, Linares Pérez M, Kelly R, Iqbal N, Chandelier F, Rex DK. Real-time differentiation of adenomatous and hyperplastic diminutive colorectal polyps during analysis of unaltered videos of standard colonoscopy using a deep learning model. Gut. 2019;68:94-100.
18. Hassan C, Spadaccini M, Iannone A, Maselli R, Jovani M, Chandrasekar VT, Antonelli G, Yu H, Areia M, Dinis-Ribeiro M, Bhandari P, Sharma P, Rex DK, Rösch T, Wallace M, Repici A. Performance of artificial intelligence in colonoscopy for adenoma and polyp detection: a systematic review and meta-analysis. Gastrointest Endosc. 2021;93:77-85.
19. Gong D, Wu L, Zhang J, Mu G, Shen L, Liu J, Wang Z, Zhou W, An P, Huang X, Jiang X, Li Y, Wan X, Hu S, Chen Y, Hu X, Xu Y, Zhu X, Li S, Yao L, He X, Chen D, Huang L, Wei X, Wang X, Yu H. Detection of colorectal adenomas with a real-time computer-aided system (ENDOANGEL): a randomised controlled study. Lancet Gastroenterol Hepatol. 2020;5:352-361.
20. Wang Z, Meng Q, Wang S, Li Z, Bai Y, Wang D. Deep learning-based endoscopic image recognition for detection of early gastric cancer: a Chinese perspective. Gastrointest Endosc. 2018;88:198-199.
21. Li JW, Wang LM, Ang TL. Artificial intelligence-assisted colonoscopy: a narrative review of current data and clinical applications. Singapore Med J. 2022;63:118-124.
22. Schöler J, Alavanja M, de Lange T, Yamamoto S, Hedenström P, Varkey J. Impact of AI-aided colonoscopy in clinical practice: a prospective randomised controlled trial. BMJ Open Gastroenterol. 2024;11:1247.
23. Misawa M, Kudo SE, Mori Y, Maeda Y, Ogawa Y, Ichimasa K, Kudo T, Wakamura K, Hayashi T, Miyachi H, Baba T, Ishida F, Itoh H, Oda M, Mori K. Current status and future perspective on artificial intelligence for lower endoscopy. Dig Endosc. 2021;33:273-284.

24. Chen PJ, Lin MC, Lai MJ, Lin JC, Lu HH, Tseng VS. Accurate classification of diminutive colorectal polyps using computer-aided analysis. gastroenterology. Gastroenterology. 2018;154:568-575.
25. Lou S, Du F, Song W, Xia Y, Yue X, Yang D, Cui B, Liu Y, Han P. Artificial intelligence for colorectal neoplasia detection during colonoscopy: a systematic review and meta-analysis of randomized clinical trials. EClinicalMedicine. 2023;66:102341.
26. Urban G, Tripathi P, Alkayali T, Mittal M, Jalali F, Karnes W, Baldi P. Deep learning localizes and identifies polyps in real time with 96% accuracy in screening colonoscopy. Gastroenterology. 2018;155:1069-1078.e8.
27. Alagappan M, Brown JRG, Mori Y, Berzin TM. Artificial intelligence in gastrointestinal endoscopy: the future is almost here. World J Gastrointest Endosc. 2018;10:239-249.
28. Repici A, Badalamenti M, Maselli R, Correale L, Radaelli F, Rondonotti E, Ferrara E, Spadaccini M, Alkandari A, Fugazza A, Anderloni A, Galtieri PA, Pellegatta G, Carrara S, Di Leo M, Craviotto V, Lamonaca L, Lorenzetti R, Andrealli A, Antonelli G, Wallace M, Sharma P, Rosch T, Hassan C. Efficacy of real-time computer-aided detection of colorectal neoplasia in a randomized trial. Gastroenterology. 2020;159:512-520.
29. Spadaccini M, Massimi D, Mori Y, Alfarone L, Fugazza A, Maselli R, Sharma P, Facciorusso A, Hassan C, Repici A. Artificial intelligence-aided endoscopy and colorectal cancer screening. Diagnostics. 2023;13:1102.
30. Kröner PT, Engels MM, Glicksberg BS, Johnson KW, Mzaik O, van Hooft JE, Wallace MB, El-Serag HB, Krittanawong C. Artificial intelligence in gastroenterology: a state-of-the-art review. World J Gastroenterol. 2021;27:6794-6824.
31. Sutton RA, Sharma P. Overcoming barriers to AI implementation in gastroenterology. Best Pract Res Clin Gastroenterol. 2021;52-53:101732.
32. Xin Y, Zhang Q, Liu X, Li B, Mao T, Li X. Application of artificial intelligence in endoscopic gastrointestinal tumors. Front Oncol. 2023;13:1239788.
33. Walradt T, Glissen Brown JR, Alagappan M, Lerner HP, Berzin TM. Regulatory considerations for AI in GI endoscopy. Gastrointest Endosc. 2020;92:801-806.
34. Parasher G, Wong M, Rawat M. Evolving role of AI in GI endoscopy. World J Gastroenterol. 2020;26:7287-7298.
35. Young E, Edwards L, Singh R. The role of artificial intelligence in colorectal cancer screening: lesion detection and lesion characterization. Cancers (Basel). 2023;15:5126.