

# Practice and Evaluation of AI-Assisted Pathological Diagnosis in Clinical Teaching of Gastrointestinal Tumors

Zengzhan Gao<sup>1</sup>, Ping Wang<sup>2</sup>, Fei Xue<sup>1\*</sup>

<sup>1</sup>Department of General Surgery II, Shaanxi Provincial People's Hospital, Xi'an 710061, Shaanxi, China

<sup>2</sup>Department of Gastroenterology I, Shaanxi Provincial People's Hospital, Xi'an 710061, Shaanxi, China

\*Author to whom correspondence should be addressed.

**Copyright:** © 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), permitting distribution and reproduction in any medium, provided the original work is cited.

**Abstract:** *Objective:* To explore the practical effects of an AI-assisted pathological diagnosis system in clinical pathology teaching for gastrointestinal tumors, and to evaluate its impact on medical students' pathological diagnostic capabilities, learning efficiency, and teaching satisfaction through comparative analysis. *Methods:* Fifty clinical medicine interns participating in gastrointestinal tumor clinical teaching in the pathology department of our hospital from March 2023 to December 2025 were selected and randomly divided into an observation group and a control group using a random number table method, each with 25 cases. The control group adopted the conventional teaching mode of traditional pathological slide demonstration combined with theoretical lectures, while the observation group conducted teaching practice using an AI-assisted pathological diagnosis system in addition to conventional teaching. The teaching period was 4 weeks for both groups. After the teaching period, unified theoretical and practical assessments of pathological slide diagnosis were conducted, and the time spent on slide reading by students in both groups was recorded. Additionally, teaching satisfaction questionnaires were distributed to compare the differences in various indicators between the two groups. *Results:* The theoretical and practical assessment scores of the observation group were significantly higher than those of the control group (both  $P < 0.001$ ). The average time spent on slide reading in the observation group was  $12.35 \pm 2.14$  minutes, while that in the control group was  $20.68 \pm 3.26$  minutes. The observation group spent significantly less time on slide reading than the control group ( $t = 10.708, P < 0.001$ ). The overall teaching satisfaction in the observation group was significantly higher than that in the control group ( $P < 0.05$ ). *Conclusion:* The application of AI-assisted pathological diagnosis in clinical teaching for gastrointestinal tumors can effectively enhance medical students' theoretical knowledge and practical diagnostic capabilities in pathology, reduce the time spent on slide reading, improve learning efficiency, and enhance teaching satisfaction. It is suitable for promotion and application in clinical pathology teaching for gastrointestinal tumors.

**Keywords:** Artificial intelligence; AI-assisted pathological diagnosis; Gastrointestinal tumors; Clinical teaching; Comparative study

**Online publication:** May 12, 2026

## 1. Introduction

Gastrointestinal tumors are highly prevalent malignant tumors of the digestive system in clinical practice. Pathological diagnosis serves as the cornerstone for confirming, classifying, staging, and formulating treatment plans for gastrointestinal tumors, and it is also a key and challenging aspect of clinical medical student education <sup>[1]</sup>. Traditional pathological teaching for gastrointestinal tumors primarily relies on theoretical lectures, microscopic demonstrations of pathological slides, and mentor-guided slide reading. However, this approach faces issues such as a monotonous teaching model, limited pathological slide resources, difficulties in identifying minute lesions, and inconsistent teaching efficiency. Particularly for junior interns, it is challenging to quickly grasp the pathological morphological characteristics and key points for differential diagnosis of gastrointestinal tumors, often resulting in suboptimal teaching outcomes <sup>[2]</sup>. With the rapid development of medical artificial intelligence (AI) technology, pathological auxiliary diagnosis systems have gradually been applied in clinical pathological diagnosis and teaching. These systems can assist in rapidly identifying lesion areas, tissue classification, and cellular morphological features in pathological slides of gastrointestinal tumors through functions such as image recognition, intelligent annotation, and lesion localization, providing a new auxiliary tool for clinical pathological teaching <sup>[3,4]</sup>. However, there are currently few controlled studies on the application of AI-assisted pathological diagnosis in specialized teaching for gastrointestinal tumors, and most existing studies focus on the technical aspects, lacking systematic evaluations of teaching effectiveness. This study selected 50 clinical interns to conduct a randomized controlled teaching practice. By comparing the effects of conventional teaching with AI-assisted teaching, it aims to provide objective evidence for optimizing the pathological teaching model for gastrointestinal tumors.

## 2. Materials and methods

### 2.1. General information

Fifty clinical medical interns who completed clinical pathological teaching for gastrointestinal tumors in the pathology department of our hospital from March 2023 to December 2025 were selected as the study subjects. The inclusion criteria were as follows: (1) Full-time undergraduate clinical medical interns with no prior systematic learning experience in gastrointestinal tumor pathology; (2) Voluntary participation in this study and cooperation in completing teaching assessments and questionnaires; (3) Completion of the entire teaching cycle without any leave or absences. The exclusion criteria were: (1) Prior exposure to pathological AI-assisted systems; (2) Presence of learning disabilities preventing normal teaching and assessment completion; (3) Unwillingness to cooperate with the study procedures.

Using a random number table method, the 50 interns were divided into an observation group and a control group, with 25 cases in each group. In the observation group, there were 12 males and 13 females, aged 21 to 24 years, with an average age of  $22.36 \pm 0.85$  years, and a theoretical foundation assessment score of  $65.23 \pm 3.42$  points. In the control group, there were 14 males and 11 females, aged 21 to 24 years, with an average age of  $22.18 \pm 0.91$  years, and a theoretical foundation assessment score of  $64.89 \pm 3.57$  points. There were no statistically significant differences in general information such as gender, age, and assessment scores between the two groups ( $P > 0.05$ ), indicating comparability. This study was reviewed and approved by the Medical Ethics Committee of our hospital, and all interns and teaching mentors provided informed consent.

## 2.2. Teaching methods

Teaching in both groups was conducted by five associate chief physicians or higher-ranking physicians in the pathology department of our hospital, each with over 10 years of experience in gastrointestinal tumor pathological diagnosis. The teaching cycle for both groups was 4 weeks, with 6 teaching hours per week. The teaching content was unified and covered core topics such as the basic pathological theory of gastrointestinal tumors, common pathological classifications, differentiation between benign and malignant lesions, and standards for writing pathological reports.

The control group adopted the traditional pathological teaching model. Theoretical lectures used PPT presentations to explain relevant knowledge points of gastrointestinal tumor pathology, including histological classifications, degrees of differentiation, depths of invasion, and criteria for judging lymph node metastasis in gastric and colorectal cancers. Practical teaching involved microscopic demonstrations of pathological slides, where teaching mentors selected typical gastrointestinal tumor pathological slides and explained lesion characteristics one by one. Interns practiced slide reading independently, and teaching mentors provided targeted answers and explanations to questions, without the intervention of AI-assisted devices.

The observation group combined the conventional teaching methods of the control group with the use of an AI-assisted pathological diagnosis system for teaching practice. The system used was a clinically available pathological auxiliary diagnosis device in our hospital, compatible with digital slide reading and intelligent auxiliary analysis of gastrointestinal tumor pathological slides. The teaching focused on utilizing the system's functions such as lesion annotation, classification prompts, error-prone point reminders, and a typical case library. The specific teaching process was as follows: (1) Theoretical lectures were synchronized with the display of typical digital cases from the system, combining abstract theory with visual pathological images; (2) During practical slide reading, interns first browsed digital pathological slides through the system and made preliminary judgments on lesion types. The system automatically annotated suspicious lesion areas and highlighted key diagnostic points. Teaching mentors then explained error-prone and differential diagnosis points based on the system's annotations; (3) After class, interns conducted independent practice using the system's question bank, retrieving and repeatedly reading different types of gastrointestinal tumor pathological slides, comparing their own judgments with those of the system and teaching mentors to reinforce knowledge point memory; (4) For difficult pathological slides, the system's auxiliary analysis was utilized to help interns quickly identify the core of the lesions and improve their differential diagnosis abilities. During the teaching process, excessive reliance on the system was avoided, and the focus was on cultivating interns' independent diagnostic thinking, with the system serving only as an auxiliary teaching tool.

## 2.3. Observation indicators and evaluation methods

(1) Teaching assessment scores: After the teaching cycle, unified theoretical and practical pathological assessments were conducted, each with a full score of 100 points. The theoretical assessment consisted of closed-book written questions covering basic knowledge points, diagnostic criteria, and differential diagnosis points of gastrointestinal tumor pathology. The practical assessment involved selecting 10 standardized gastrointestinal tumor pathological slides (covering types such as gastric cancer, colorectal cancer, gastrointestinal intramucosal cancer, and precancerous lesions). Interns independently read the slides and issued pathological diagnosis opinions. Two blinded teaching mentors scored the assessments

according to unified scoring criteria, and the average score was taken as the practical assessment result. All scores were rounded to two decimal places.

- (2) Slide reading time: During the practical assessment, the total time taken by each intern to read 10 pathological slides and issue diagnosis opinions was recorded, and the average slide reading time for both groups was calculated and rounded to two decimal places.
- (3) Teaching satisfaction: After the teaching, a self-made teaching satisfaction questionnaire was distributed. The questionnaire covered five dimensions: teaching model, learning efficiency, knowledge point mastery, teaching effectiveness, and overall satisfaction, with a total score of 100 points. Scores of 90 points and above were considered very satisfied, 70 to 89 points were considered satisfied, and below 70 points were considered unsatisfied. The overall satisfaction rate was calculated as (number of very satisfied cases + number of satisfied cases) / total number of cases  $\times$  100.00%, with the satisfaction percentage rounded to two decimal places.

## 2.4. Statistical methods

Data analysis was performed using SPSS 22.0 statistical software. Measurement data were expressed as mean  $\pm$  standard deviation (SD), and comparisons between groups were conducted using independent sample *t*-tests. Count data were expressed as [*n* (%)], and comparisons between groups were conducted using  $\chi^2$  tests. A *P*-value  $<$  0.05 was considered statistically significant.

## 3. Results

### 3.1. Comparison of teaching assessment scores between the two groups

The theoretical and practical assessment scores in the observation group were significantly higher than those in the control group (both *P*  $<$  0.001), as detailed in **Table 1**.

**Table 1.** Comparison of teaching assessment scores between the two groups (points, mean  $\pm$  SD)

Group	Theoretical assessment score	Practical assessment score
Observation group ( <i>n</i> = 25)	89.65 $\pm$ 4.23	90.12 $\pm$ 3.87
Control group ( <i>n</i> = 25)	78.34 $\pm$ 5.16	79.56 $\pm$ 4.62
<i>t</i>	8.476	8.743
<i>P</i>	$<$ 0.001	$<$ 0.001

### 3.2. Comparison of average time spent on slide reading between the two groups

The average time spent on slide reading in the observation group was 12.35  $\pm$  2.14 minutes, while that in the control group was 20.68  $\pm$  3.26 minutes. The observation group spent significantly less time on slide reading than the control group (*t* = 10.708, *P*  $<$  0.001).

### 3.3. Comparison of teaching satisfaction between the two groups

The overall teaching satisfaction in the observation group was significantly higher than that in the control group (*P*  $<$  0.05), as detailed in **Table 2**.

**Table 2.** Comparison of teaching satisfaction between the two groups [*n* (%)]

Group	Very satisfied	Satisfied	Unsatisfied	Overall satisfaction rate
Observation group ( <i>n</i> = 25)	19 (76.00)	5 (20.00)	1 (4.00)	24 (96.00)
Control group ( <i>n</i> = 25)	10 (40.00)	7 (28.00)	7 (28.00)	17 (68.00)
$\chi^2$	—	—	—	6.640
<i>P</i>	—	—	—	0.010

## 4. Discussion

The pathological diagnosis of gastrointestinal tumors is highly specialized and involves complex morphological characteristics, encompassing multiple knowledge points such as precancerous lesions, carcinoma *in situ*, invasive carcinoma, tissue classification, and degree of differentiation [5]. Traditional teaching models rely heavily on the experience and demonstrations of teaching mentors, with most pathological slides being physical specimens that offer poor repeatability. Minute and atypical lesions are often difficult to display clearly, requiring interns to repeatedly review slides to grasp core concepts, resulting in a long learning cycle and low efficiency. Particularly for interns lacking clinical experience, it is challenging to quickly locate lesion areas during independent slide reading, leading to a high risk of missed or misdiagnosed cases, which undermines teaching confidence and learning outcomes.

The results of this study indicate that the observation group achieved significantly higher scores in both theoretical and practical assessments compared to the control group, with a notably shorter average slide reading time. This suggests that the AI-assisted pathological diagnosis system can effectively enhance the quality of pathological teaching for gastrointestinal tumors, helping medical students rapidly acquire knowledge and improve their practical pathological diagnostic skills [6]. The reasons for this are as follows: The AI-assisted system digitizes physical pathological slides, establishing a standardized database of gastrointestinal tumor pathology cases, thereby overcoming the limitations of limited slide resources and poor demonstration effects in traditional teaching. The system automatically annotates lesion areas and highlights core diagnostic features, enabling interns to quickly identify key lesions and reduce ineffective slide reading time. Additionally, it provides intelligent prompts for error-prone points and differential diagnosis considerations, compensating for the inadequacies of incomplete demonstrations and insufficient explanations in traditional teaching [7,8]. Furthermore, the system supports repeated playback and independent practice, allowing interns to selectively reinforce weak areas based on their individual learning needs, achieving personalized teaching. Compared to the monotonous demonstration model in traditional teaching, this approach better stimulates learning initiative and accelerates the absorption and comprehension of knowledge points [9].

The teaching satisfaction survey revealed that the overall satisfaction rate in the observation group was significantly higher than that in the control group, indicating that interns had a higher level of acceptance for the AI-assisted teaching model. Traditional teaching models are often boring and passive, with interns primarily in a state of passive knowledge reception. In contrast, AI-assisted teaching combines theory with visual images, offering a more flexible and intuitive teaching format that reduces the difficulty of pathological learning and enhances its interest [10]. Meanwhile, with the aid of the system, interns can quickly receive diagnostic feedback and promptly correct misconceptions, fostering a sense of academic achievement

and thereby increasing satisfaction with the teaching model <sup>[1]</sup>.

It is important to note in teaching practice that the AI-assisted pathological system serves only as a teaching aid and cannot replace the guidance and explanations provided by teaching mentors. The teaching process should adhere to the principle of “student-centered, mentor-guided, and system-assisted,” avoiding excessive reliance on the system by interns and focusing on cultivating their abilities in independent slide reading, logical judgment, and independent diagnosis. For difficult and atypical gastrointestinal tumor pathology cases, it is essential to integrate the clinical experience of teaching mentors with system-assisted analysis to help interns establish a comprehensive diagnostic mindset, balancing learning efficiency with the cultivation of practical clinical skills.

This study has certain limitations. The sample size was limited to 50 cases, the teaching cycle was relatively short, and it was a single-center teaching study. Subsequent research could expand the sample size, extend the teaching follow-up period, and conduct multi-center studies to further validate the long-term effects of this teaching model. Additionally, stratified teaching research could be conducted for medical students with different educational backgrounds and learning foundations to optimize the application of AI-assisted teaching.

## 5. Conclusion

In conclusion, the application of the AI-assisted pathological diagnosis system in clinical pathological teaching for gastrointestinal tumors can significantly enhance medical students’ mastery of theoretical knowledge and practical diagnostic skills, effectively reduce slide reading time, improve learning efficiency, and substantially increase teaching satisfaction. It represents an efficient and feasible teaching model for gastrointestinal tumor pathology, worthy of further promotion and optimization in clinical teaching.

## Funding

- (1) Development and Trial of a Magnetic Anastomosis Device for Primary Intestinal Reconstruction in the Context of Abdominal Infections (Grant No.: 2022YJY-07)
- (2) Research on the Regulatory Effects and Mechanisms of SASH1 on Gastric Cancer Tumorigenesis and Pyroptosis (Grant No.: 2024JC-YBMS-704)

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Xu F, Wang F, Lin L, et al., 2022, Application Effects of MDT Combined with PBL in Undergraduate Interns in Gastrointestinal Surgery. *China Continuing Medical Education*, 14(05): 66–69.
- [2] Niu L, Liu H, Cai Y, et al., 2021, Application and Reflection of Clinical Pathological Actual Cases in CPPT Teaching. *Basic Medical Education*, 23(11): 760–764.
- [3] Chang Y, Qian Y, 2021, Application of Artificial Intelligence in Pathology Teaching. *China Continuing Medical*

Education, 13(11): 88–91.

- [4] Li L, Liu C, Zhang H, et al., 2025, Application and Challenges of Artificial Intelligence Technology in the Training of Cardiac Surgeons. *China Medicine*, 20(12): 1868–1871.
- [5] Liu L, Wang H, 2014, Experience and Discussion on the Practical Teaching of Gastrointestinal Tumor Surgery. *Xinjiang Medical Journal*, 44(01): 133–135.
- [6] Bian L, Xia D, Kong L, et al., 2026, Application of the BOPPPS Teaching Model Combined with Scenario Simulation Teaching Method Based on Artificial Intelligence in the Clinical Practice of Intern Nurses in Joint Surgery. *Nursing Research*, (07): 1–7.
- [7] Gao L, Zhang H, Zhang Y, et al., 2026, Advances in the Application of Artificial Intelligence in Tumor Imaging. *Chinese Journal of Surgical Oncology*, 18(01): 22–30.
- [8] Chen L, Sun K, Wu J, et al., 2025, Full-Stack Full-Spectrum: Exploration and Application of Artificial Intelligence in Medical Imaging. *Journal of Image and Graphics*, 30(06): 2187–2206.
- [9] Qin C, Yi R, Wu Z, et al., 2026, Exploration of the Application of Generative Artificial Intelligence Technology in Graduate Course Teaching. *Journal of Higher Education*, 12(01): 9–14.
- [10] Yu S, Chen S, 2025, Multidimensional Innovations and Trends in the Diagnosis and Treatment of Esophageal Cancer in the Era of Artificial Intelligence. *Journal of Fujian Medical University*, 59(05): 296–303.
- [11] Yu H, Wu H, Wang H, et al., 2025, Application of Innovative Teaching Models in the Teaching of Integrated Traditional Chinese and Western Medicine Proctology. *Chinese Journal of Colorectal Diseases*, 45(10): 74–78.

**Publisher's note**

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.