

# Construction and Application of a Teaching System for Early Diagnosis and Treatment of Gastrointestinal Tumors

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**Abstract:** *Objective:* To construct a standardized and practical teaching system for the early diagnosis and treatment of gastrointestinal tumors, evaluate its application effect in clinical teaching and practice, and provide a reference for improving the early diagnosis and treatment level of gastrointestinal tumors and optimizing medical teaching models. *Methods:* Fifty clinicians (including residents, visiting doctors, and standardized training doctors) who participated in teaching and training related to the diagnosis and treatment of gastrointestinal tumors in our hospital from January 2023 to December 2025 were selected as the study subjects. They were randomly divided into an observation group (25 cases) and a control group (25 cases) using a random number table method. The control group adopted the traditional teaching model for gastrointestinal tumors, while the observation group applied the self-constructed integrated teaching system for early diagnosis and treatment of gastrointestinal tumors. The theoretical assessment scores, practical skill assessment scores, and mastery of knowledge related to the early diagnosis and treatment of gastrointestinal tumors were compared between the two groups, as well as the detection rate of early gastrointestinal tumors and the implementation rate of standardized diagnosis and treatment in clinical practice after teaching. *Results:* After the teaching intervention, the theoretical assessment scores and practical skill assessment scores in the observation group were significantly higher than those in the control group ( $P < 0.001$ ); the excellent rate of knowledge mastery in the observation group was significantly higher than that in the control group ( $\chi^2 = 5.357, P = 0.021 < 0.05$ ); clinical practice data six months after teaching showed that the detection rate of early gastrointestinal tumors and the implementation rate of standardized diagnosis and treatment in the observation group were significantly higher than those in the control group ( $P < 0.001$ ). *Conclusion:* The constructed teaching system for the early diagnosis and treatment of gastrointestinal tumors can effectively improve the theoretical knowledge and practical skills of trainees, strengthen their clinical capabilities in early diagnosis and treatment, enhance the detection efficiency and diagnostic and therapeutic standardization of early gastrointestinal tumors, and possess high value for clinical teaching promotion.

**Keywords:** Gastrointestinal tumors; Early diagnosis and treatment; Teaching system; Clinical teaching; Standardized training; Early detection rate

**Online publication:** April 17, 2026

## 1. Introduction

Gastrointestinal tumors are highly prevalent malignant tumors in the clinical digestive system, including gastric cancer, colorectal cancer, and tumors at the gastroesophageal junction. In recent years, their incidence has been rising annually and showing a trend toward younger patients, posing a severe threat to public health<sup>[1]</sup>. Clinical studies have confirmed that the prognosis of patients with gastrointestinal tumors is closely related to the timing of diagnosis and treatment. The 5-year survival rate of patients with early-stage tumors exceeds 90% after minimally invasive endoscopic treatment or radical surgical resection, whereas the survival rate of patients with advanced-stage tumors declines significantly, accompanied by high treatment costs and numerous complications. Therefore, early diagnosis and treatment are pivotal for improving the prognosis of patients with gastrointestinal tumors<sup>[2,3]</sup>. Currently, the ability of primary-level and young-to-middle-aged clinicians in China to diagnose and treat gastrointestinal tumors early varies considerably. Traditional teaching methods predominantly rely on theoretical instruction, lacking practical training, case-based learning, and standardized procedural training. This results in clinicians having inadequate mastery of core knowledge, such as the endoscopic features of early gastrointestinal tumors, screening procedures, indications for minimally invasive treatment, and pathological interpretation, leading to frequent issues such as missed diagnoses, misdiagnoses, and non-standardized treatment in clinical practice. Based on this, this study constructed an integrated teaching system for the early diagnosis and treatment of gastrointestinal tumors, addressing the pain points in clinical teaching. A controlled study involving 50 clinicians was conducted to evaluate the teaching effectiveness and clinical application value, with the results reported as follows.

## 2. Materials and methods

### 2.1. General information

Fifty clinicians who participated in the teaching and training program for the diagnosis and treatment of gastrointestinal tumors in the Department of Gastroenterology, Department of Gastrointestinal Surgery, and Endoscopy Center of our hospital from January 2023 to December 2025 were selected as the study subjects. The inclusion criteria were as follows: (1) engaged in gastrointestinal-related clinical work and required to master core skills for the early diagnosis and treatment of gastrointestinal tumors; (2) voluntarily participated in this study and cooperated with teaching assessments and clinical data collection; (3) completed the entire teaching cycle without withdrawal. The exclusion criteria were as follows: (1) previously received systematic specialized training in the early diagnosis and treatment of gastrointestinal tumors; (2) had less than 1 year of clinical work experience and lacked basic clinical experience; (3) were unable to cooperate with various assessments and data follow-up. All participants provided informed consent for this study, which was reviewed and approved by the Medical Ethics Committee of our hospital.

Using a random number table method, the 50 clinicians were divided into an observation group and a control group, with 25 cases in each group. Observation group: 14 males and 11 females; aged 23–38 years old, with an average age of  $(28.64 \pm 3.27)$  years old; work experience ranging from 1 to 6 years, with an average of  $(2.85 \pm 1.13)$  years; 12 residents, 8 standardized training physicians, and 5 visiting physicians. Control group: 13 males and 12 females; aged 22–39 years old, with an average age of  $(28.41 \pm 3.56)$  years old; work experience ranging from 1 to 5 years, with an average of  $(2.72 \pm 1.08)$  years old; 13 residents, 7 standardized training physicians, and 5 visiting physicians. There were no statistically significant differences in general information, such as gender, age, work experience, and job type, between the two groups ( $P > 0.05$ ), indicating comparability.

## **2.2. Methods**

### **2.2.1. Control group**

The traditional teaching method, combining classroom lectures with teaching rounds, was adopted. The teaching content primarily focused on the basic theory and conventional diagnosis and treatment plans for gastrointestinal tumors. The course schedule included two 90-minute theoretical sessions per week. Clinical teaching mainly involved explaining conventional cases without specialized practical training in early diagnosis and treatment. The teaching cycle lasted for 3 months, followed by a unified assessment.

### **2.2.2. Observation group**

Based on clinical diagnosis and treatment guidelines and teaching practice, a five-in-one teaching system for the early diagnosis and treatment of gastrointestinal tumors was constructed, encompassing “theoretical elaboration, practical training, case-based learning, procedural standardization, and assessment feedback.” The teaching cycle also lasted for 3 months, with the specific implementation as follows:

#### (1) Theoretical Elaboration Module

This module focused on the core theories of early diagnosis and treatment of gastrointestinal tumors, covering epidemiology, screening criteria for high-risk populations, pathological classification of early lesions, endoscopic morphological characteristics, application principles of chromoendoscopy and magnifying endoscopy, indications and contraindications for minimally invasive treatment, and postoperative follow-up management standards. A combination of PPT presentations, guideline interpretations, and expert lectures was used, supplemented by illustrated case atlases. The key points for differentiating easily missed or misdiagnosed lesions were emphasized, with weekly 120-minute theoretical Q&A sessions to solidify the theoretical foundation of the participants.

#### (2) Practical Training Module

A stepwise teaching approach of “hands-on guidance, simulated operations, and real-patient practice” was adopted. Participants first mastered basic operations such as standardized endoscope insertion and withdrawal, mucosal observation, biopsy, and staining using endoscopic simulators. Subsequently, they received one-on-one guidance from senior clinicians to perform real gastrointestinal endoscopies, focusing on training standardized observation procedures for the esophagus, stomach, and colorectum and enhancing skills in identifying changes in mucosal color, morphology, and vascular patterns indicative of early cancer. Simultaneously, the clinical applications of magnifying endoscopy and narrow-band imaging (NBI) were taught, ensuring that each participant completed no fewer than 30 standardized gastrointestinal endoscopy practices.

#### (3) Case-Based Learning Module

Typical and challenging cases of early gastrointestinal tumors and precancerous lesions diagnosed in our hospital over the past 5 years were collected. Weekly 90-minute case discussions were held, during which participants independently analyzed case images and pathological results and formulated screening, diagnosis, treatment, and follow-up plans. Teaching clinicians provided on-site evaluations and corrections. Additionally, participants were arranged to participate in the entire process of clinical early cancer screening clinics and endoscopic diagnosis and treatment, following the team from high-risk population assessment to postoperative follow-up. Weekly 90-minute case seminars were also conducted to accumulate practical experience.

#### (4) Procedural Standardization Module

A standardized procedural manual for the early diagnosis and treatment of gastrointestinal tumors was developed, covering the entire process from high-risk population screening, endoscopic examination, pathological diagnosis, treatment plan selection, to postoperative management. It clarified operational standards and quality control requirements for each step, and participants were organized to memorize and strictly implement them, with regular spot checks on procedural compliance.

(5) Assessment Feedback Module

A mechanism combining formative and summative assessments was established. Monthly mini-assessments were conducted to promptly provide feedback on participants' weak areas, with targeted supplementary teaching and learning. After the teaching cycle, comprehensive theoretical and practical assessments were carried out, and participants' clinical practice data were tracked to form a closed loop of teaching-assessment-improvement.

### 2.3. Observation indicators

(1) Teaching Assessment Indicators

After the teaching cycle, unified theoretical and practical skill assessments were conducted, with full scores of 100 points each. Higher scores indicated better mastery.

(2) Excellent Knowledge Mastery Rate

The excellent knowledge mastery rates of the two groups were calculated. Scores were categorized as excellent ( $\geq 90$  points), good (80–89 points), pass (60–79 points), and fail ( $< 60$  points). The excellent knowledge mastery rate was calculated as (number of excellent cases + number of good cases) / total number of cases  $\times 100\%$ .

(3) Clinical Practice Indicators

Clinical work data of the two groups within 6 months after teaching were tracked. The detection rate of early gastrointestinal tumors (number of early gastrointestinal tumor cases / total number of gastrointestinal tumor screening cases during the same period  $\times 100.00\%$ ) and the compliance rate of standardized diagnosis and treatment for gastrointestinal tumors (number of standardized diagnosis and treatment cases / total number of gastrointestinal tumor diagnosis and treatment cases during the same period  $\times 100.00\%$ ) were calculated.

### 2.4. Statistical methods

SPSS 23.0 statistical software was used for data processing. Measurement data conforming to a normal distribution were expressed as mean  $\pm$  standard deviation (SD), and independent sample t-tests were used for intergroup comparisons. Count data were expressed as [n (%)], and  $\chi^2$  tests were used for intergroup comparisons. All data were retained to two decimal places, and  $P < 0.05$  indicated a statistically significant difference.

## 3. Results

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

After the teaching intervention, the observation group scored significantly higher than the control group in both theoretical assessment and practical skills assessment ( $P < 0.001$ ). See **Table 1** for details.

**Table 1.** Comparison of teaching assessment scores between the two groups

Group	Theoretical Exam Score (points, mean ± s)	Practical Skills Exam Score (points, mean ± SD)
Observation Group (n = 25)	92.36 ± 3.42	90.58 ± 4.15
Control Group (n = 25)	81.24 ± 5.76	78.62 ± 6.33
<i>t</i>	8.302	7.901
<i>P</i>	< 0.001	< 0.001

### 3.2. Comparison of the excellent rate of knowledge mastery between the two groups

The excellent rate of knowledge mastery in the observation group was significantly higher than that in the control group ( $\chi^2 = 5.357, P = 0.021 < 0.05$ ), as detailed in **Table 2**.

**Table 2.** Comparison of the excellent rate of knowledge mastery between the two groups

Group	Excellent (n)	Good (n)	Pass (n)	Fail (n)	Excellent and Good Rate [n (%)]
Observation Group (n = 25)	18	6	1	0	24 (96.00)
Control Group (n = 25)	10	8	5	2	18 (72.00)
$\chi^2$					5.357
<i>P</i>					0.021

### 3.3. Comparison of clinical practice indicators between the two groups

Clinical practice data collected six months after the teaching intervention revealed that the detection rate of early gastrointestinal tumors and the implementation rate of standardized diagnosis and treatment in the observation group were significantly higher than those in the control group ( $P < 0.001$ ), as detailed in **Table 3**.

**Table 3.** Comparison of clinical practice indicators between the two groups

Group	Total Screening Cases	Number of Early Tumor Detections	Early Detection Rate (%)	Total Diagnosis and Treatment Cases	Number of Standardized Diagnosis and Treatment Cases	Standardized Implementation Rate (%)
Observation Group (n = 25)	643	183	28.45	208	196	94.23
Control Group (n = 25)	625	96	15.37	199	153	76.89
$\chi^2$	-	-	31.694	-	-	25.042
<i>P</i>	-	-	< 0.001	-	-	< 0.001

## 4. Discussion

The early diagnosis and treatment of gastrointestinal tumors represent a core task in the prevention and control of digestive system tumors, with the professional competence of clinicians directly determining the detection rate of early-stage tumors and the quality of diagnosis and treatment. Therefore, constructing a scientifically sound teaching system and strengthening specialized skills training are crucial approaches to enhancing the level of early diagnosis and treatment of gastrointestinal tumors<sup>[4,5]</sup>. Traditional teaching models for gastrointestinal tumors suffer from drawbacks such as an emphasis on theory over practical skills, a focus on advanced-stage tumors rather than early lesions, and fragmented content lacking in systematic organization. As a result, trainees

find it difficult to translate theoretical knowledge into practical clinical skills, often exhibiting inadequate identification capabilities and non-standardized operations when facing early, concealed lesions, thus failing to meet the demands of early clinical diagnosis and treatment.

The integrated teaching system for early diagnosis and treatment of gastrointestinal tumors constructed in this study breaks through the limitations of traditional teaching by centering on the core objective of “early detection, early diagnosis, and early treatment.” It integrates all aspects of theory, practical skills, case studies, procedures, and assessments to form a closed-loop teaching model. The theoretical module focuses on core knowledge points, avoiding the cramming of redundant information, and helps trainees quickly grasp key theories for early diagnosis and treatment. The practical skills module combines simulated training with clinical practice, providing one-on-one targeted instruction to solidify core skills such as endoscopic operations and lesion identification. The case study module reviews typical and challenging cases to cultivate trainees’ clinical thinking and enhance their practical abilities. The procedural module clarifies standardized diagnosis and treatment procedures to reinforce diagnostic and therapeutic norms. The assessment module provides timely feedback on teaching effectiveness and targets areas of weakness for improvement, comprehensively enhancing trainees’ overall capabilities <sup>[6,7]</sup>.

From the research results, it is evident that trainees in the observation group who adopted the integrated teaching system demonstrated significant advantages across all assessment indicators: their theoretical assessment scores and practical skills assessment scores were markedly superior to those of the control group using traditional teaching methods, and the excellent rate of knowledge and skill mastery was substantially higher than in the traditional teaching group. This fully confirms that the teaching system can efficiently help trainees grasp core knowledge and acquire practical skills <sup>[8]</sup>. More importantly, from a clinical perspective, when the teaching outcomes were translated into actual clinical practice, the early gastrointestinal tumor detection rate among physicians in the observation group reached 28.45%, and the rate of standardized diagnosis and treatment implementation reached 94.23%. Both core clinical indicators were significantly better than those in the control group, indicating that this teaching model can genuinely be translated into clinical execution capabilities, effectively reducing missed and misdiagnosed cases of early lesions and standardizing overall diagnostic and therapeutic behaviors.

During the subsequent promotion and implementation of this teaching approach, it is essential to flexibly optimize teaching plans based on actual conditions to accommodate the differentiated needs of trainees at various levels. For grassroots physicians and young residents with weaker foundations, the focus should be on strengthening basic practical skills training and instilling standardized diagnosis and treatment procedures to lay a solid foundation for their practice. For senior physicians and key medical staff, the emphasis should be on in-depth analysis of complex and challenging cases, as well as training in cutting-edge diagnostic and therapeutic techniques and interpretation of the latest guidelines, to help them enhance their ability to manage difficult cases <sup>[9]</sup>. Simultaneously, teaching content must keep pace with industry developments, with regular updates to incorporate the latest domestic and international guidelines on early diagnosis and treatment of gastrointestinal tumors, advancements in endoscopic techniques, and clinical research findings, ensuring the timeliness and clinical applicability of the teaching materials <sup>[10]</sup>. Additionally, it is recommended to establish a long-term teaching tracking and consolidation mechanism, including regular refresher training and case discussion seminars, to continuously reinforce teaching outcomes, prevent skill regression, and promote sustained and steady improvements in the level of early diagnosis and treatment of gastrointestinal tumors.

## 5. Conclusion

In summary, compared to traditional teaching models, the teaching system for early diagnosis and treatment of gastrointestinal tumors can significantly enhance clinicians' theoretical knowledge and practical skills, effectively improve the detection rate of early gastrointestinal tumors and the standardization of diagnosis and treatment, and demonstrate remarkable teaching effectiveness and clinical application value. It is suitable for promotion and application in the clinical teaching of gastrointestinal tumors at hospitals of all levels, contributing to the comprehensive advancement of early diagnosis and treatment efforts for gastrointestinal tumors in China.

## Funding

Experimental Study on the Construction of Splenorenal Shunt for the Treatment of Portal Hypertension Using Magnetic Compression Technology (Project No.: 2022M712598); Study on the Regulatory Role and Mechanism of SASH1 in the Tumorigenesis and Pyroptosis of Gastric Cancer (Project No.: 2024JC-YBMS-704)

## Disclosure statement

The authors declare no conflict of interest.

## References

- [1] Hou J, Zhang J, Hou Z, 2019, Research Progress on Integrin-Linked Kinase and Its Role in Digestive Tract Tumors. *Medical Review*, 25(22): 4444–4448.
- [2] Lin Z, Bai X, Wu Z, et al., 2025, New Dimensions in the Diagnosis and Treatment of Early Colorectal Cancer: From Auxiliary Diagnosis to Precision Surgery. *Practical Journal of Clinical Medicine*, 22(05): 7–12.
- [3] Cheng X, 2024, Advances in Minimally Invasive Surgical Treatment of Gastric Cancer. *Modern Practical Medicine*, 36(08): 981–984.
- [4] Xu Z, Zhen Y, 2023, Promoting the Prevention, Diagnosis, and Treatment of Gastrointestinal Tumors Through Advancements in Biological Technologies. *Journal of Laparoscopic Surgery*, 28(01): 1–6.
- [5] Chen W, Li N, Lan P, et al., 2021, Guidelines for Screening and Early Diagnosis and Treatment of Colorectal Cancer in China (2020, Beijing). *Chinese Journal of Oncology*, 30(01): 1–28.
- [6] Yu Y, Chen X, 2026, Research on the Effectiveness of Cognitive Load Theory-Oriented Teaching in Cultivating Core Competencies Among General Surgery Interns. *Health Vocational Education*, 44(01): 62–65.
- [7] Wang R, 2025, Exploration of Teaching Reform in Comprehensive Nursing Skills Training Courses Based on Competency-Based Education. *Teaching in Forest Regions*, (12): 43–46.
- [8] Liu F, 2025, Research on the Construction of Information-Based Teaching Resources for Integrated Work-Study Courses Under the Background of the “Three Educations” Reform. *China Information and Computer*, 37(16): 218–220.
- [9] Feng L, Huang J, Yang Q, et al., 2026, Application of Multidisciplinary Integration in the Clinical Practice of Pathology Professional Degree Postgraduates. *Basic Medical Education*, (03): 291–295.
- [10] Hao X, Wang D, 2024, *Abdominal Oncology*. People's Medical Publishing House, Beijing.

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